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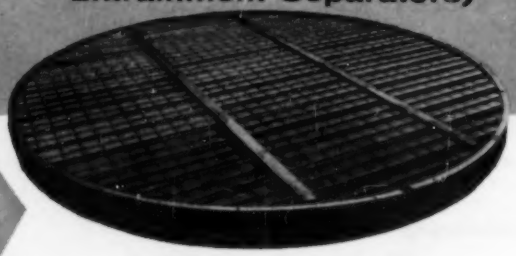

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Rigorous Quality, Not Quantity

Ralph E. Flanders
U.S. Senator, Vermont

THERE is a false impression that the United States is lacking in scientists and engineers, and has been falling woefully behind the Soviet Union in these respects. In support of this false assumption, attention is called to the enormous numbers of students in these two subjects now studying in Soviet schools and graduating from them yearly. The comparison is true so far as numbers are concerned. However, we do not need to feel too much disturbed as to quality of our engineers, but rather as to the increasing difficulty faced by the engineering schools in producing this quality.

The launching of Sputnik I did raise questions as to the quality of our scientific and engineering personnel. Fears with regard to this are quite groundless. Had we wished to do so, had we had the wisdom and the foresight to have done so, we could have had a satellite in the air months before Sputnik I was launched. That we could have done this was proved by the fact that the Army's Jupiter C launched a satellite with apparatus which had been designed and engineered months before. *We were all ready to go, but the command to go was withheld.*

Extended visits to the various centers of missile development and production in this country on both coasts and in the South, made it clear to me that we have an immense reservoir of talented young scientists and engineers devoting their trained and experienced intelligence to our missile program. It is inconceivable to me that any country on earth is better provided with men of this type. *Our satellite failures so far have been largely those of administration.*

Considering the matter of quantity of these students and graduates, evidence is accumulated that the pipeline is full, and that the flow is sufficient or more than sufficient to meet the demands. I have surveyed the opinion of those having particular responsibilities for education in those fields. Last November we had a conference in our office with a large number of the representatives of science having headquarters here in Washington. This conference very definitely revealed deficiencies in the training of students coming to our colleges. These deficiencies extended to the whole range of their preparatory courses, but for my purpose special attention was paid to mathematics and science.

Similarly, I have made inquiry of those concerned with engineering education, who have come to much the same conclusion. The organizations particularly interested in personnel, such as the Engineers and Scientists of America and the National Society of Professional Engineers, offer evidence that there is no longer the limitless demand for young men to enter these fields that appeared earlier. Information from the placement officers of various engineering schools is to the same effect.

This opinion is re-enforced by the Engineering Manpower Commission of the EJC joining with the Scientific Manpower Commission. This brings together the best experience and opinion on this subject from the professional societies both of science and engineering. Their survey of the 1957 situation indicates the highest engi-

continued on page 8

From testimony of Ralph E. Flanders before the Committee on Labor and Public Welfare, in support of Education Bills, S. 3156, S. 3157, and S. 3352, March 12, 1958.

Thurber, that's high school stuff

Can effective writing be made easy? Some say yes, have definite methods for improving the quality, speeding the output of their pens. Other men have no such luck. Recently, an admission of the difficulties of writing was made by one of the seemingly most prolific and effortless professional writers in America today —James Thurber. The following brief extract from a published interview with Thurber is offered here as a comfort for all engineers, scientists, or anyone else, who, in spite of all diligence, training and experience, still find writing a difficult task.—ED.

Interviewers: Is the act of writing easy for you?

Thurber: For me it's mostly a question of rewriting. It's part of a constant attempt on my part to make the finished version smooth, to make it seem effortless. A story I've been working on—"*The Train on Track Six*," it's called—was rewritten fifteen complete times. My wife took a look at the first version of something I was doing not long ago and said, " . . . Damn it, Thurber, that's high-school stuff." I have to tell her to wait until the seventh draft, it'll work out all right. For me, writing fast would seem too facile. . .

Interviewers: Does it bother you to talk about the stories on which you're working? It bothers many writers, though it would seem that particularly the humorous story is polished through retelling.

Thurber: Oh yes. I often tell them at parties and places. And I write them there, too.

Interviewers: You write them?

Thurber: I never quite know when I'm not writing. Sometimes my wife comes up to me at a party and says, "Dammit, Thurber, stop writing." She usually catches me in the middle of a paragraph. Or my daughter will look up from the dinner table and ask, "Is he sick?" "No," my wife says, "he's writing something." I have to do it that way on account of my eyes. I still write occasionally—in the proper sense of the word—using black crayon on yellow paper and getting perhaps twenty words to the page. My usual method, though, is to spend the mornings turning over the text in my mind. Then in the afternoon, between two and five, I call in a secretary and dictate to her. I can do about two thousand words. It took me about ten years to learn. . .

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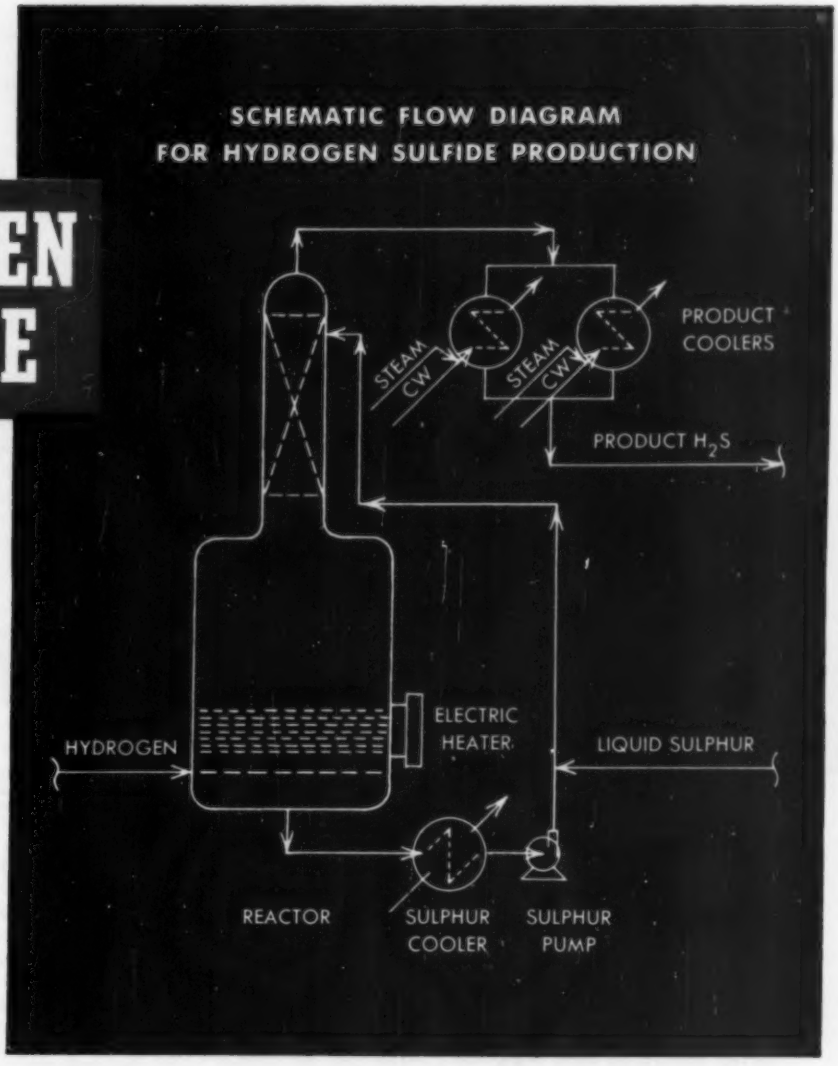
HYDROGEN SULFIDE

New Girdler process supplies hydrogen sulfide for ore concentration



The first large-scale hydrogen sulfide plant used in ore processing is being engineered by Girdler. Part of a nickel processing plant of Cuban American Nickel Company at Moa Bay, Cuba, the plant will produce 60 tons per day of hydrogen sulfide from hydrogen and sulfur. The hydrogen sulfide will be used to concentrate limonite ore and produce nickel and cobalt sulfide for shipment to the United States. Girdler is also engineering and equipping a hydrogen plant and storage facilities for the Cuban project as well as hydrogen sulfide production facilities in the United States for refining the ore concentrate.

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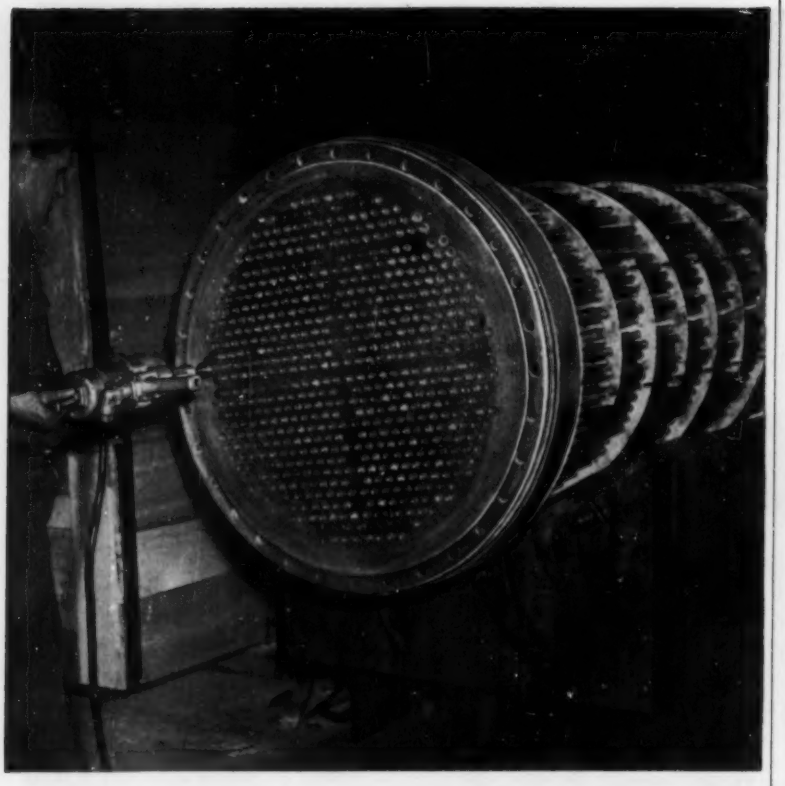

Tricky assembly job handled with ease...at Downingtown

Specs said: Roll type 329 stainless tubes into type 316 and 304 tube sheets. A tricky problem, since the 329 tubes are 15-20 points harder on the Rockwell B scale than the 304 and 316 tube sheets.

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Design Pressure: Shell —125 psi at 300° F.
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noted and quoted

from page 6

neering enrollment in history and likewise the second highest freshman enrollment. The number of bachelor degrees granted is the greatest ever, as is the number of master degrees. However, in the upper ranges of scholarship the number of doctorates declined. [Their survey] reports "The major problem is no longer one of student recruitment, but of educational *quality* all along the line and the provision of adequate facilities and faculties for higher education in engineering and science. We see no compelling reason for altering that basic emphasis."

I am, therefore, convinced that *quantity* of such students and graduates is not our problem.

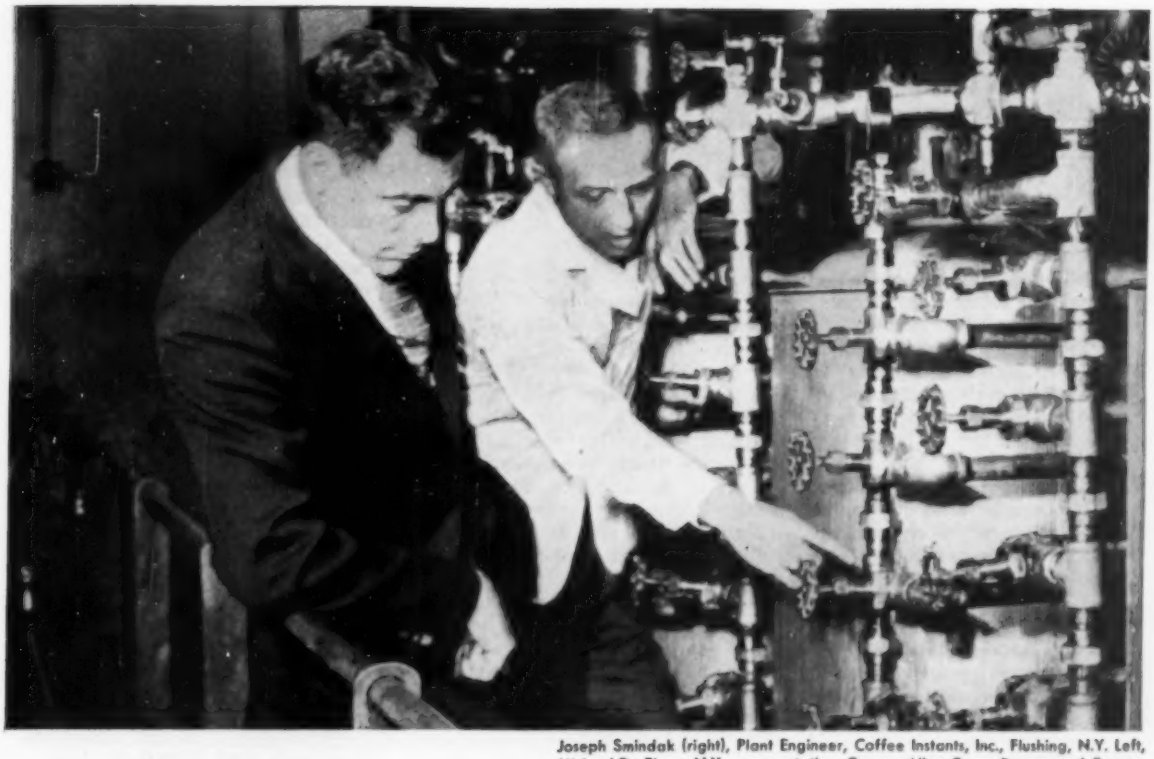
At an M. I. T. regional convention in Washington, March 1, dean Harrison, the M. I. T. School of Science, told the group that American education is "rotting at the roots" because of "progressive education." This type of education was needed to break the "shell" around the educational system at one time, he said, but a "new shell" must now be developed.

"Students coming to M. I. T. can't read, write or spell," the Science Dean complained, "and some don't know the alphabet. Truck drivers know more than teachers" he continued, "but this is to be expected because they are better paid."

At the same meeting, Dr. Killian in his final remarks warned against an overemphasis on the role of the scientists. Humility and a sense of proportion are needed, he said, to prevent an adverse or indifferent reaction to science.

[Then too, secondary school] training constitutes a dangerous weakness at the very heart of American society. [Needed are measures which will] strengthen the preparation of our young people for the hard world of a cold war indefinitely prolonged, of a hot war that may break out at any time, and of that stalemate of terror from many sides which overhangs their everyday lives.

Therefore I have . . . introduced Senate Bill S. 3175 . . . The bill has a very simple purpose. It is to put so high a premium on real scholarship that the demand for it will arise spontaneously from parents and students. It likewise seeks to establish competition in scholarship between the secondary schools of a state, and between the states themselves. #



Joseph Smindak (right), Plant Engineer, Coffee Instants, Inc., Flushing, N.Y. Left, Michael De Piano, N.Y. representative, Cooper Alloy Corp. Foreground, Cooper Alloy 1" stainless Union Bonnet Globe Valves.

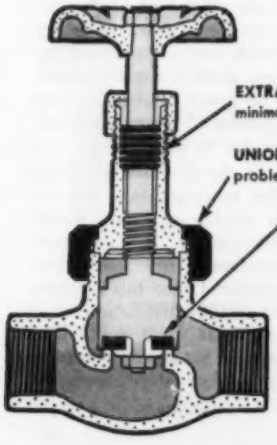
SMINDAK of COFFEE INSTANTS, INC.

Tells why he specifies Cooper Alloy for stainless steel valves and fittings

Q. Mr. Smindak, why does Coffee Instants, one of the nation's leading instant coffee processors, use stainless valves and fittings in processing their product?
A. To protect product purity, a must with us as with most other food processors. Contact with other metals can degrade flavor and aroma; stainless steel does not.

Q. Why Cooper Alloy?
A. Because of the special Cooper Alloy construction features I find combined in no other brand. On these Cooper Alloy union bonnet globe valves, for example, we like the ease of operation and the low maintenance; the fact that it removes a threaded joint from product contact; and in particular, the extra-deep square-compression stuffing box which reduces maintenance, gives a tighter seal at stem. Then too, the excellent service we get from Cooper Alloy sales people and distributors.

Q. You don't find these features in any competing valve?
A. Frankly, not one has them all. That's why, for our stainless valves *and fittings*, we insist on Cooper Alloy.


EXTRA-DEEP STUFFING BOX holds minimum 6 turns Blue African asbestos
UNION BONNET JOINT eliminates problems found in screwed-in bonnets
RETAINED RENEWABLE DISC for tight seal and long life

COOPER ALLOY Figure 15RD Globe Valve, inside screw rising stem, 200-lb. service, screwed ends, renewable retained disc of composition you specify.

YEARS AHEAD IN DESIGN SUPERIORITY! No matter what your valve type—globes, gates, angles, checks, or Y's—the Cooper Alloy model's outstanding design features will be important to you. Cooper Alloy, with 35 years of pioneering experience in stainless steel, does not merely adapt existing brass and iron valve patterns; it creates valves *designed to be cast in stainless!* **Check the special design features of valve shown at left.**

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Literature classification–Another view

Mr. Swanton's excellent statement of the problem pointed out that engineering information and literature *cannot* now be retrieved effectively. At this time, when it is urgent that we achieve greater effectiveness in our technical work, it is essential that we be able to retrieve all pertinent information on past technical developments so that we can do better jobs quicker and at a lower cost. As Mr. Swanton points out, we must reduce the "vast economic waste due to lost time, duplication of effort, and less perfect than necessary designs."

Mr. Swanton notes that the technical societies have done very little to bring about solutions to this problem. This is not surprising, because too many management personnel seem to be unaware of the existence of the problem. Even our technical people often seem to prefer to be "original and creative" (with mediocre results) rather than to build constructively upon information developed by others in the past. It is apparent that a great deal of education must be carried on in this area.

It *is possible* to solve the technical problem of information retrieval–and to solve it in a fairly simple fashion (as will be pointed out below). However, the method proposed by Mr. Swanton–a broadly applicable subject classification system–cannot work, for reasons too numerous to list here. Some of the best proofs that classifications cannot be *economically practicable and simultaneously effective* information retrieval tools can be found in the writings of Perry (Western Reserve University) and Taube (Documentation, Inc.). Suffice it to say that classifications are effective retrieval tools only when any of the following conditions prevail: (1) the subject matter is narrow in scope, (2) the classification will be used only by a small group of people who can learn it well and agree upon its categorizing conventions, (3) the number of documents involved is small or (4) the useful life of the classification need not be long. None of these conditions apply to the literature of engineering.

As Dr. Mantell notes in his comment upon Swanton's letter a plethora of classifications *has* been developed and only a *few* have had workability–and those only because one or more of the above conditions prevailed. The most famous (and most worked-over) classification of all, the Dewey Decimal Classification, is today used as a retrieval device by only a few libraries. The "Bolles Classification" (see Petroleum Refiner, May, 1949), mentioned by Mr. Swanton, does not work either–as the writer can testify based upon long experience with it. The fact that these devices are not generally applicable is not the fault of poor design by their makers; rather it is because classifications are fundamentally unsuited for effective information retrieval. They have proved for decades to be the pot of gold at the end of the rainbow; success has always been just over the next hill.

While classifications will not solve the general problem of information retrieval (nor will conventional alphabetical indexes–for much the same reasons), a relatively new and simple technique known as "concept coordination" *can* solve the problem. At least two papers on this subject will be presented on June 24, 1958, during the "New Horizons in Management Symposium," which will be a part of the Golden Jubilee Conference in Philadelphia. The readers of this column are accordingly referred to that Symposium for further information on retrieval techniques and other new "tools" for both management and technical personnel.

Other than the fact that Mr. Swanton proposes a classification system, rather than a concept coordination system, I am highly in favor of his proposal and believe that it should receive urgent attention from the Institute.

EUGENE WALL

Newark,
Delaware

More on Swanton

I was glad to receive a copy of the letter which Swanton sent you concerning improvement of literature searches. While I do not believe this is connected with the Symbols and Nomenclature Committee, as an individual I cannot help but think that Swanton is talking about an important problem.

We all know what an enormous problem has resulted from the continued expansion of chemical abstracts. Surely some data processing machine must be used in the future for classification. Russia is making great progress on the basis of translating and keeping abreast of our books and magazines. We should be doing the same with Russian literature.

I would support any effort to increase the efficiency of literature searches.

F. M. TILLER
Dean of Engineering
University of Houston
Houston, Texas

Saline Water

January 21, 1958.

Dear Sir:

I read with great interest Mr. Gillman's article on U. S. Saline Water Conversion on Page 68 of the December issue of CHEMICAL ENGINEERING PROGRESS. I would like to suggest that there is a point of view which differs in several essentials from the one taken in his article, and this view is summarized as follows:

1. There is a tremendous divergence between prices people pay for natural fresh water and prices that they must pay for converted saline water (see a very interesting article in the January issue of the JOURNAL of the American Water Works Association entitled, "Cost of Water Treatment in California" by Gerald T. Orlob and Marvin R. Lindorf).

2. The most optimistic predictions one could make on the basis of present saline water conversion technology show that fresh water produced by the membrane process from brackish sources will be lower in absolute cost than water produced from sea water or brackish water by distillation.

3. Hence, on the all-important basis of water price, the membrane process has a better chance of being useful sooner. Unfortunately, the emphasis of the Department of Interior's Saline Water Conversion Office has recently been on sea water distillation, and it has tended in its publicity to blur the distinctions between types of saline water sources and conversion

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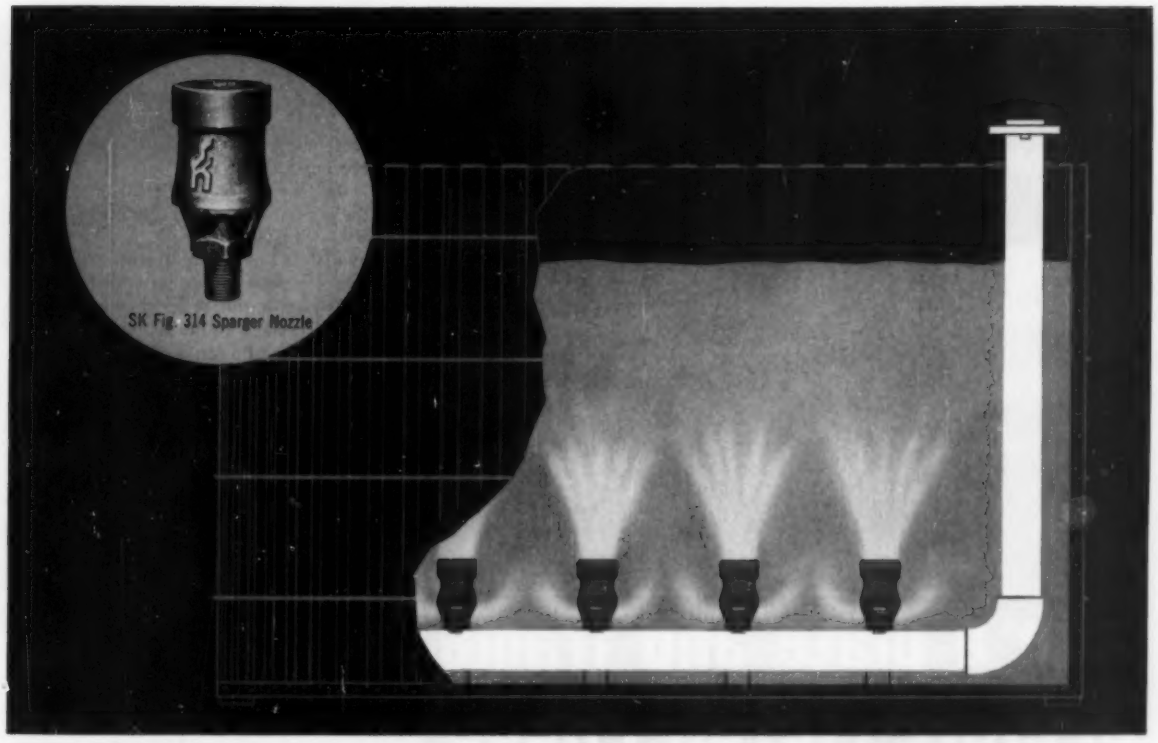

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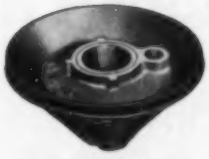

SK Fig. 301 Noiseless Heater for Tank Heating

SK Fig. 315 Circulating Heater for Tank Heating

SK Fig. 320 Continuous Heater for Pipe-Line Heating

SK Fig. 327 Slurry Heater for Pipe-Line Heating

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The illustration above shows tank heating being accomplished using SK Sparger Nozzles—one of the several types of Heaters offered by SK. Units of this type are ideal for use where uniform agitation is required over a large shallow tank area. In operation, a jet of steam issuing through the nozzle entrains tank liquid through the suction opening. Condensation takes place immediately upon mixing of liquid and steam and the stream of heated liquid is discharged at considerable velocity providing constant agitation.

Several other types of SK Steam Jet Heaters—for both tank and pipe-line heating—are shown at left. Complete details on all types are contained in Bulletin 3A which is available on request.

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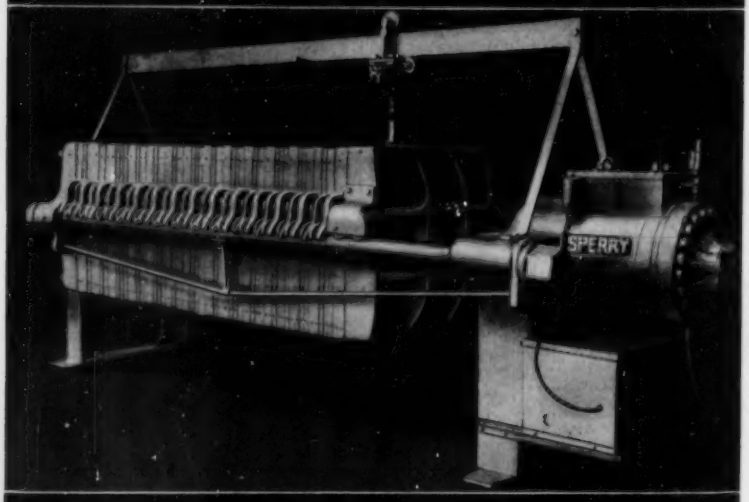

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letters to the editor

from page 10

methods which lead to the important economic difference.

4. There are large inland areas in the United States and elsewhere where sea water is, practically speaking, not available but where the more attractive brackish water is available. For these areas, the brackish water-membrane process route is the only practical route to more fresh water.

I don't believe that the public has been sufficiently alerted to these facts, and as a consequence, the overwhelming percentage of public time, attention, and money has been focused on the sea water situation.

I am happy to say that in publishing a paper which I wrote on this subject in the April, 1957, issue of CEP, the Editors inserted a boxed background statement entitled, *How Close Is Large-Scale Sea Water Purification?*, in which the point of view I have been setting forth here was mentioned. We believe that a repetition and expansion of this viewpoint is needed until brackish water receives at least equal prominence with sea water, if a clear picture of saline water economics is to emerge.

William E. Katz,
Ionics, Incorporated

Contra teen-agers

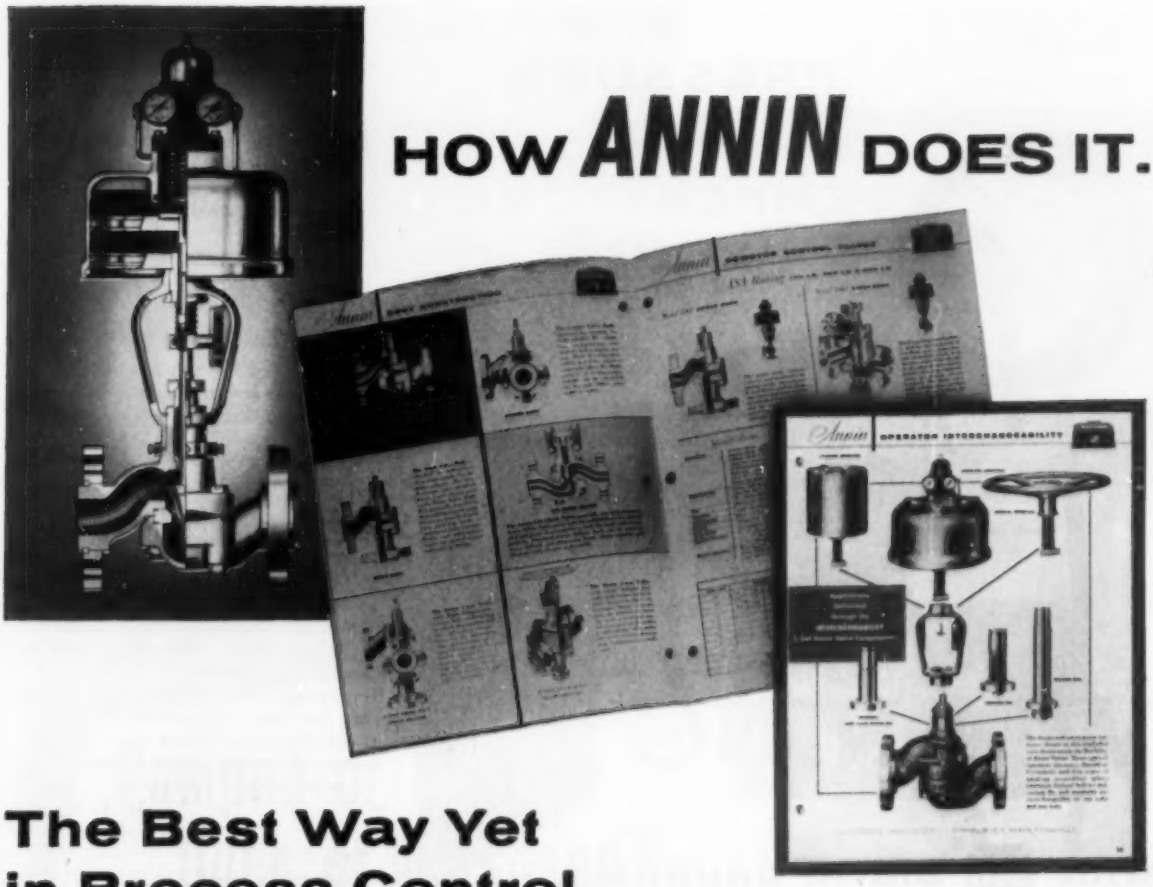
February 5, 1958

Dear Sir:

I was interested in your editorial in the January issue of CEP. I am not at all surprised at the opinions about scientists quoted therein. I am disturbed however, by the moderation of your comments: "Thus there is now positive evidence that far too many people in our country regard scientists in an unfavorable and, we believe, unrealistic light." The opinions expressed by the teen-agers are grossly insulting to a class of people to whom they are greatly in debt. It is good that you "believe" these opinions are unrealistic, but you and the Purdue Opinion Research Panel could have gone much farther. Vital statistics on scientists should have been tabulated alongside the opinions. There is one other thing the Purdue boys can attempt to establish: do teen-agers really think, or do they just think they are thinking?

I agree that science needs effective public relations; this is precisely what I proposed to Victor Chemical Company in its talent contest a year ago.

continued on page 14



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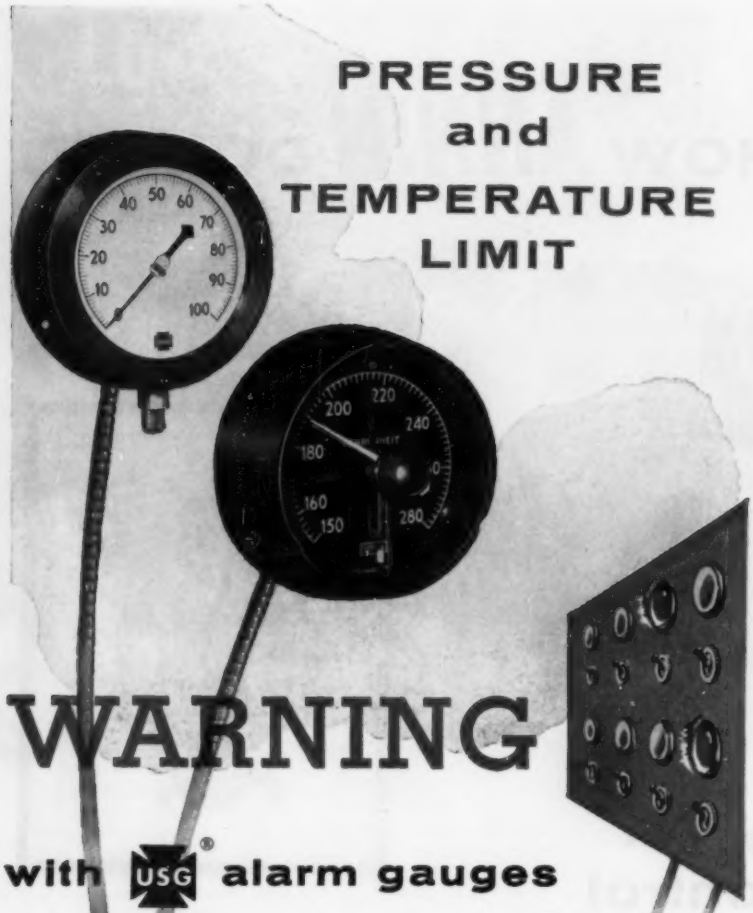

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letters to the editor

from page 12

The vast majority of young people, however, are more concerned about the undesirability of appearing to be nonconformist, than in building useful lives.

Frank P. Vance

Idaho Falls, Idaho

Books for Pago Pago

Would you like to share your scientific books and magazines with students of limited resources? If so, send them to:

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M. J. Senter
Director of Education

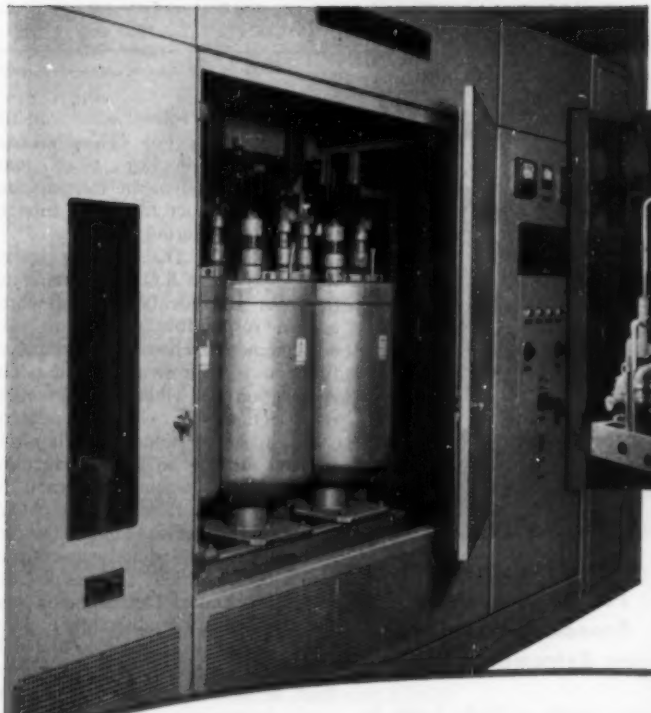
Pago Pago,
American Samoa

Test tube to tank car

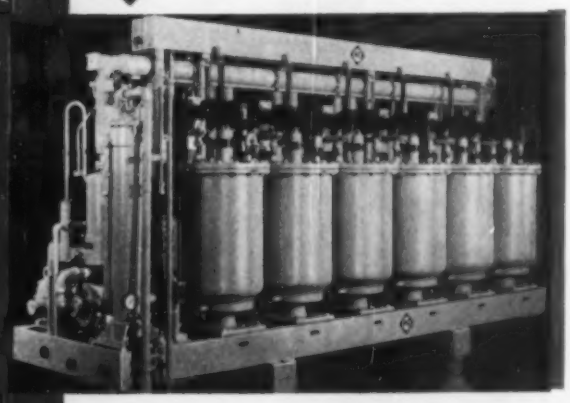
Among the many interesting symposia at the recent annual meeting of the Institute in Chicago, the interest shown in the two excellent sessions on new product development clearly demonstrated wider recognition by chemical engineers of their growing participation in, and responsibilities for, this important phase of chemical industry. Despite the fact that many registrants were turned away under the controlled attendance plan, the relatively small group of about 100 facilitated free and informal discussion. The competent panel members stimulated good questions and provided illuminating answers.

What struck me especially significant was that the topics discussed were largely the same that have been intensively examined by the Commercial Chemical Development Association for the past ten years, and by its predecessor group, the Technical Service Group, for four years before that. In 1943, a half-dozen members of A.I.Ch.E. at the Pittsburgh meeting, including Frank Curtis, Bill Bowman, Jim Boyd, Bill Harding, the writer,

continued on page 16



Open pumped tube unit permits easy access for inspection. Easy to recondition in field.



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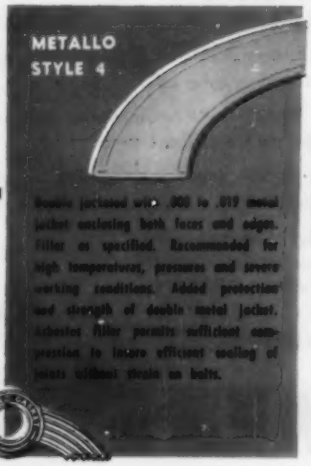

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letters to the editor

from page 14

and one or two others, conceived the idea that some degree of systematization might be brought to the sequence of steps involved in the development of a new product from test tube to tank car, and started T.S.G.

In 1947 C.C.D.A. was organized from, and by, T.S.G., numbering today over 400 members, all of whom are in responsible charge of various commercial chemical development functions in their own companies. The Association as a whole is an excellent cross-section of our chemical industry.

As in other fields, the literature bearing directly on new product development has become voluminous, in no small measure due to C.C.D.A. members themselves. The best of this material was distilled and concentrated into a book entitled "Successful Commercial Chemical Development," under the dedicated editorship of Hoyt M. Corley of Armour & Co., and published by John Wiley & Sons, New York, in 1954. Sponsored by C.C.D.A., each chapter was prepared by a different subcommittee of authorities chosen by the Editorial Board. So far as I know, it is the only book dealing with the ramifications of this quite modern technological discipline primarily for the chemical industry.

At the close of the Chicago symposium, with the chairman's permission I asked for a show of hands on how many had heard of this reference dealing with the subject to which they were devoting the day. About six hands were raised. The others indicated great interest in the name of the book and its publisher.

It is apparent that there is much interest on the part of A.I.Ch.E. members in this subject. It is equally apparent that what is probably the best, if not the only, available text is relatively unknown to the majority. This can probably be explained in terms of the healthy and rapid growth of the membership, especially in younger chemical engineers. It might be helpful if this book were publicized more widely by either or both the C.C.D.A. and the publishers.

Since the technics of new product development are a function of the rate at which the chemical industry is changing, this book, now about five years old, might become the springboard for a future symposium of A.I.Ch.E. at which the subject was reviewed and updated, perhaps with the cooperation of C.C.D.A.

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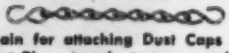

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SCOPE

Chemical Executive Warns on Use of Forecasts

The sound investment decision is one where intuitive reasoning, hard, cold facts, and mathematical conclusions, are combined in the right proportions, said R. B. McPherson, Chief Economist, Du Pont of Canada, addressing a management symposium at the recent A.I.Ch.E.-C.I.C. meeting in Montreal. "Our forecasts are most harmful," continued McPherson, "when we take them seriously. The use of all mathematical forecasts contains an element of danger because they are expressed in quantitative terms and take on, in the mind of the reader, a degree of accuracy which belies the facts."

One of the most striking changes of the past two decades has been the gradual departure from the intuitive, "seat-of-the-pants", type of investment decision, and its replacement by the more formal mathematical approach, complained McPherson. Undoubtedly, the more scientific approach represents progress, in other ways. But the gain has been purchased at a price. Our preoccupation with figures has tended to obscure the fact that we are still dealing with *an art and not a science*, he emphasized.

In recent years in the chemical industry, we have seen overproduction in some sectors, underproduction in others; construction of "white elephants" in times of prosperity, missed opportunities in times of depression. The culprit, according to McPherson, is inaccurate forecasting. Mathematical shortcuts, he said, have tended to preclude search for the basic factors on which judgment must be founded. Mathematics does not gamble, does not experiment, does not take calculated risks; it can only project the present and, in so doing, must necessarily neglect factors – economic, social, political, psychological–which can not be expressed by strict mathematical equations. Mathematics should be the servant, not the master.

Management, insisted McPherson, should not be content to accept one overall forecast of costs, sales, or profits. Instead, the aim should be to single out and evaluate each separate influence that exerts a major determining effect on the end results. Management, having been supplied with such facts, is in a position to then apply business judgment rather than to rely on any mathematical compilation of the various factors.

From the long-term point of view, concluded McPherson, industry perhaps should pay more attention to those forces that lie outside the realm of industry generally. As a result of the sharp cyclical downturn of this year, management will probably no longer be content to base its forecasts on the long-term rate of growth. Henceforth, we will accept the fact that periods of excess prosperity and of regression are inevitable, and adjust our forecasts accordingly. Some day, in considering new investment, senior managements may raise their standards during periods of prosperity, and lower requirements during recessions, when it is known that the estimates presented by their organizations have been deflated of their excess optimism.

A.I.Ch.E. Formally Inducted into UET as Founder Society

Formal approval by the last of the other four societies has completed acceptance of A. I. Ch. E. as a Founder Society in United Engineering Trustees; this marks the first time in forty-two years that a national engineering society has been admitted to membership. On the fund raising front for the new United Engineering Center to be erected on United Nations Plaza in New York, the Greater New York Business Campaign, which is expected to provide sizeable funds, was recently gotten under way. William H. Byrne, general chairman of the N. Y. Campaign, has stated that more than $3 million of the $10 million needed has already been subscribed by industry and the membership of the five Founder Societies. Said Mayor Wagner of New York City, "The City will offer every form of aid possible to the construction of this worthwhile project, which will be another addition to the city's claim that it is the world center for service organizations."

ASEE Urges 233% Jump in Engineering Teachers' Salaries

By 1967, says the American Society for Engineering Education, America will need 7,000 more engineering teachers at an average salary of $12,500, an increase of 105% over today's average. The estimated total salary bill should be about $200 million, says ASEE. Figures are based on results of a two-year study; polled were the heads of most of the nation's engineering schools. An immediate across-the-board increase of about 40% is indicated, says the ASEE committee, if academic jobs are to be competitive with non-teaching opportunities; thus, full professors should be jumped at once from an average of $900 per month to $1,350, instructors from $487 to $700.

European Chemical Industry Leaders Back Economic Union

An emerging pattern of international economic cooperation was clearly evident recently as leading spokesmen for the Western European chemical industry participated in the recent A.I.Ch.E.-C.I.C. Chemical Engineering Conference in Montreal, reviewed chemical industry progress in their respective countries and expressed their hopes for the future.

Pacemakers in the drive for the realization of the projected European Common Market are the Benelux countries—Belgium, The Netherlands, Luxembourg—which have already achieved a large measure of economic integration. "Benelux is setting an example of free enterprise at work which could well become the economic pattern of the free world", said Paul Ferrero, research director of the Belgian chemical company Societe Carbochimique. Concrete results were cited by Ferrero: between 1948 and 1956, total exports from Belgium to The Netherlands rose from $19 million to $37.8 million, while in the opposite direction, the figure from the Netherlands to Belgium was $22.4 million in 1956 against only $7.4 million in 1948. As a result of the progress already made, says Ferrero, institution of the Common Market should cause a minimum of disruption in the national economies of the Benelux countries.

The West German chemical industry is unlikely to regain the dominating position it once held in the world market, said Karl Winnacker, president of Farbwerke Hoechst, Frankfort, one of the largest West German chemical firms. Lack of essential raw materials was pinpointed by Winnacker as the basic weak point of the West German chemical industry. He pointed out that, up to 1945, hydrocarbons from coal constituted almost the sole basis of the industry. Today, insufficient supplies of these products are forcing a changeover to production of hydrocarbons from petroleum which must be imported. At the same time, said Winnacker, the once flourishing German sulfuric acid industry, based largely on imported pyrites, is now threatened by the increasing Mexican production of elemental sulfur and by the large-scale recovery of sulfur from newly-tapped natural gas deposits in France. Although post-war West German recovery has been phenomenal, "the German chemical industry is looking forward with eager expectation to the development of the European Common Market which, though it will involve great sacrifices, may confer great benefits on all its members", concluded Winnacker.

Spokesmen for France and Italy, both justly proud of their countries' post-war progress in the development of their chemical industries, also came out strongly for European economic integration. "A great experiment is now being attempted in our old Europe, recently weakened by two terribly destructive wars", said J. J. Desportes, President and General Manager of France's Etablissements Kuhlmann; "this is the creation of the European Common Market, which is now coming progressively into operation. The paramount condition for its success is the need—on all sides— to abandon the spirit of domination . . ."

Existence of the Common Market would speed up both national and international competition, in the view of Giulio Natta of the Polytechnic Institute of Milan, Italy. Natta went on to point out that the Italian contribution to such an economic union would be

continued on page 21

More Engineers Advocated for Government Policy Jobs

Major decisions on weapons are often made by persons of such caliber that they would be unable to find technical employment on a competitive basis outside the government, said recently Lawrence H. O'Neill, professor of electrical engineering at Columbia University. His remedy—more top-flight engineers and scientists in government policy positions.

Cyanamid to Make Maleic Anhydride

Construction will get under way within three months on a 14 million-pound-per-year maleic anhydride unit adjacent to Cyanamid's existing production facilities at Bridgeville, Pa. Completion and operation are scheduled for late 1959. Design and construction will be by Scientific Design Co.

World's Largest Copper Smelter Goes for $20 Million Cash

The Garfield Copper Smelter of American Smelting and Refining, near Salt Lake City, Utah, will be acquired by Kennecott Copper for approximately $20 million in cash, under the terms of a recent agreement between the two firms. The giant smelter, which has a capacity of 625,000 tons of concentrate yearly, will continue to process ore from Kennecott's Bingham mine; custom smelting for other producers will, however, be discontinued, says Kennecott.

Urge Five Full-Scale Saline Water Conversion Plants

To meet an "impending fresh water shortage in the United States," a Senate subcommittee has unanimously approved a resolution calling for immediate construction of five full-scale conversion plants for demonstration purposes.

Merck to Use Japanese Process for Monosodium Glutamate

A "unique and technically advanced fermentation process," developed and licensed by Kyowa Fermentation Industry of Japan, will be used by Merck in a new production unit for monosodium glutamate at its Cherokee Plant, Danville, Pa. Investment cost will be about $4.2 million, start-up is slated for early this summer.

Power Directly From Heat in Near Future?

"We are apparently on the verge of a breakthrough in the conversion of heat to electric power through thermoelectric couples." This was the recent testimony of Rear Admiral Armand M. Morgan, U. S. Navy, appearing before a subcommittee of the House Committee on Appropriations. "In the past," the Admiral continued, "we have had such couples, but their efficiency has been low, that is, a fraction of 1 percent. More sophisticated efforts have gotten up to about 1 percent. We are now in a field of endeavor which, if successful, will enable us to get efficiencies comparable to those obtained with conventional power plants."

The statement was in regard to Navy research on the generation of electric power directly from heat.

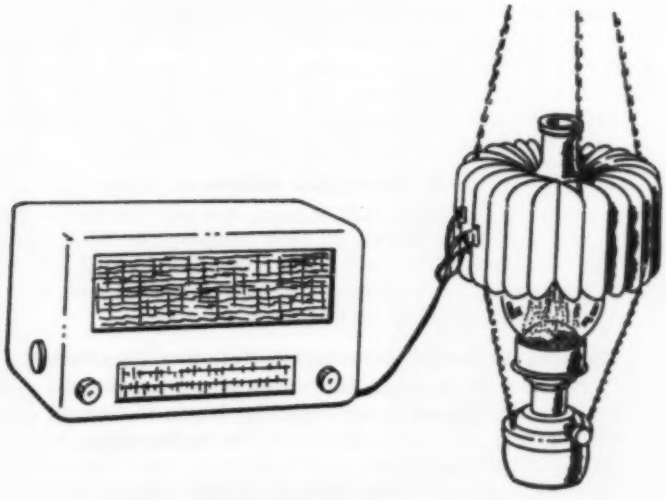
Questioned on the time table for these studies, Admiral Morgan replied: "They will continue for several years. In this fiscal year, we have asked for money from the emergency fund to continue the development. We had some funds reprogrammed into it. In 1959 . . . the support is considerably more. We should have something definite on this in a matter of 3 years."

The system being investigated by the Navy is not new; the principle involved was reported by Seebeck to the Prussian Academy of Sciences in the eighteen twenties. Present interest in the matter has been stimulated by the fact that the small difference of potential generated by heating one junction and cooling the other junction of two dissimilar electrical conductors can be multiplied to consequential proportions by increasing the temperature difference between the hot and cold junctions, and by connecting a great number of such thermocouples in series.

A recent Russian book, "Semiconductor Thermoelements and Thermoelectric Cooling" by Ioffe (English version, 1957, Infosearch, Ltd, London) discusses the application in Russia of thermoelectric systems. One application described consists of a thermoelectric generator that uses the heat of an ordinary kerosene lamp to operate a 7-tube radio. The unit is rated at 2 or 3 watts (see illustration). Admiral Morgan's researchers in the Bureau of Ships in Washington are reported to have one of these Russian kerosene lamp-operated radios in the laboratory. The generator comprises a series of 168 zinc-antimony versus constantan thermocouples hooked up in series with the hot sides next to the lamp chimney. The cold sides are located on the outer periphery of the annulus, which is kept cool by vertical aluminum fins that extend radially outward.

While the primitive kerosene lamp generator now operating in the Navy's laboratory shows an efficiency of a fraction of one percent, systems of improved design are alleged to have achieved efficiencies approaching 10%. There is doubtless considerable basis in fact for Admiral Morgan's optimistic testimony on the Navy's exploration of this long-known thermoelectric phenomenon.

—*J. L. Gillman, Jr.*



Largest Commercial Contract for Beryllium

Awarded by the Centre d'Etude de l'Energie Nucleaire (CEN) of Belgium to Brush Beryllium is a contract totalling $1,200,000 covering fabrication of two core matrices for Belgian Reactor-2, a high-flux materials and engineering test reactor now under construction at Mol, Belgium.

Economic Union

continued from page 20

important in the chemical field. Italy, ahead of most European countries, turned from coal to petroleum as a source of raw materials for chemical products. This, in conjunction with the opening up of the large natural gas fields in Northern Italy, has led to an amazing development in the petrochemical industry.

Chemical industry production, up 85% in 1956 since 1948, has grown at about double the rate for British industry in general, said R. Holroyd, Deputy Chairman of Imperial Chemical Industries, London. This increased productivity, in Holroyd's opinion, reflects the high degree of mechanization and instrumentation in the modern chemical industry.

"No comment", was Holroyd's answer to questions as to the possibility of British participation in the projected European Common Market. In regard to the threat of Soviet competition in the chemical field, he said, however, that such competition might well prove a stimulus to the inventive and productive capacity of the West.

SCOPE

Government Committee Deplores Excessive Secrecy

Initial recommendations call for extensive reform

Recent investigation into the question of access to classified and unclassified technical information, carried out by the Special Subcommittee on Government Information of the House Committee on Government Operations, has resulted in some far-reaching conclusions, and a set of recommendations for immediate action.

Says a report, just released by the Committee on Government Operations: "By compounding security regulations with restrictive rules, by adding 'need-to-know' requirements to clearance procedures, the Federal Government has mired the American scientist in a swamp of secrecy. The study completed so far of the problems posed by burgeoning restrictions on the flow of scientific information, supports the following initial conclusions:

1. When a basic scientific discovery becomes applied science and is shaped into a weapon, that process as well as the workings of the weapon itself should be classified properly and guarded very closely. But, between the two poles of pure scientific thinking and applied science, lies a vast, ill-defined area of scientific knowledge and endeavor.

2. The Nation's scientific progress . . . has been severely hampered by excessive secrecy regulations administered by the Department of Defense.

3. One of the most confusing efforts of the advocates of excessive secrecy is the attempt to classify the basic laws of nature. . . . Instead, the nation should guard closely the elite security secrets in the field of applied science.

4. Once a bit of scientific information has been classified, it is an uphill, often impossible, task to declassify it. . . . This delays the flow of ideas among scientists working on defense projects, and completely blocks access by scientists outside the defense program.

5. The multiple-clearance system [separate clearances and related access restrictions, by Army, Navy, Air Force, AEC] for scientists who need access to technological information also delays scientific progress. . . .

6. The 'need-to-know' criterion . . . has the effect of erecting another barrier between the American scientist and the information necessary to the performance of his duties. . . ."

The report goes on to make the following recommendations:

"1. A system of uniform security clearance, applying to all scientists working for all agencies and defense contractors should be established. . . .

2. The 'need-to-know' criterion should be abolished. . . .

3. There should be no attempts to hide discoveries of the basic laws of nature made in the past, present, or future."

The Committee expects to have further hearings and to make further reports. No doubt legislation will grow out of this work with which technologists will have to live for years to come. —*J. L. Gillman, Jr.*

Engineering Societies Offer Aid to President

The establishment of an advisory group of engineers to serve the United States Government was recently recommended in a communication addressed to the presidents of what were then the four Founder Societies by Representative J. W. McCormack of Massachusetts, majority leader in Congress. The letter, a copy of which went to J. R. Killian, Jr. for comment, also stressed the confusion in the minds of the general public regarding the differentiation between science and engineering. As a result of this action, Engineers Joint Council, on behalf of all the principal national engineering societies of the United States, has sent a letter to President Eisenhower, offering the individual and collective cooperation of the member societies in the solution of the many technological problems that affect our security and economy.

National Research Pulls Out of Escambia

Electric Bond and Share and United Gas have acquired the interest of their former partner, National Research Corp., in the Escambia Chemical Corp. The four-year-old Escambia plant at Pensacola, Fla., is capitalized at about $25 million, turns out ammonia, nitric acid, polyvinyl chloride, methanol.

B. F. Goodrich to Spend $35 Million in 1958

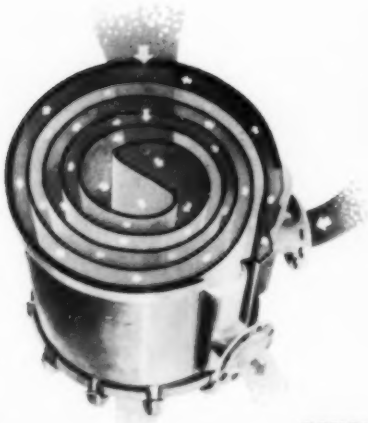
Despite a decline of 11.8% in sales, and narrower profit margins for the first three months of 1958 compared to 1957, Goodrich has announced that it will spend $35 million in 1958 for capital expenditures and investments. Company officials term the decision "an expression of confidence in the future."

Cooking Chemicals Recovered, Pollution Eliminated

Recovery of magnesia and sulfur, plus a bonus of by-product steam, is the reward being reaped by Brown Company's successful effort to eliminate pollution of the Androscoggin river at its Berlin, New Hampshire, pulp and paper mill. Conversion to a magnesium-base cooking process permits continuous operation of a new recovery furnace, said to be largest of its type in the world. Cost of recovery plant—$5.5 million.

First Major High Energy Fuel Contract to Callery

A $31,367,663 operating and production contract has been awarded to Callery Chemical by the Navy for startup of its Muskogee, Okla., high energy fuel plant and for production of a "classified" amount of HiCal. First production is slated for early 1959.



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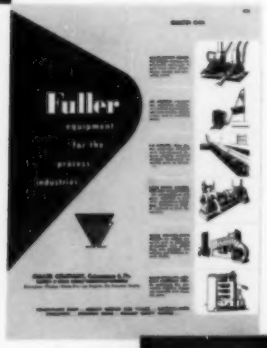

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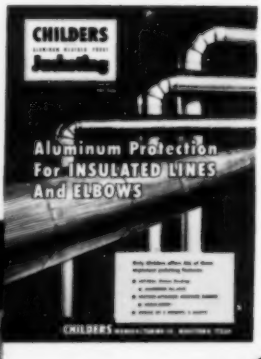

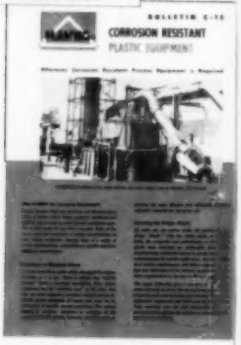

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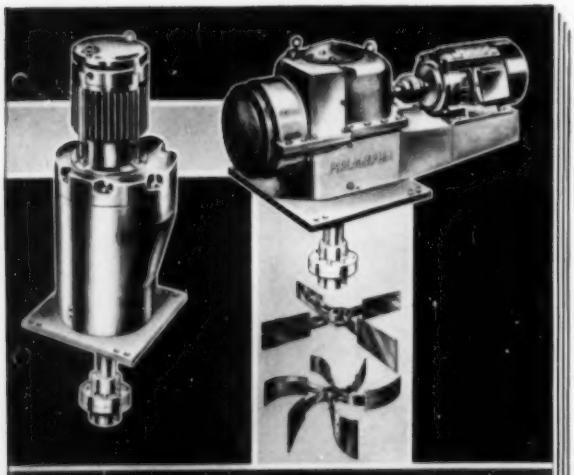

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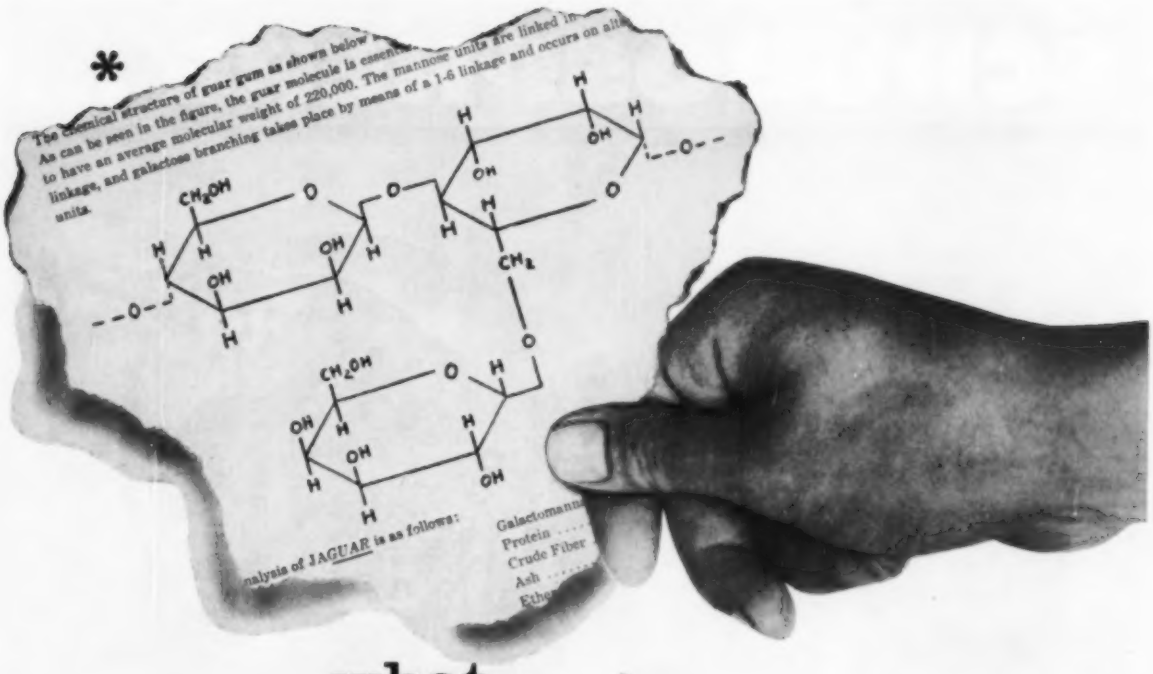
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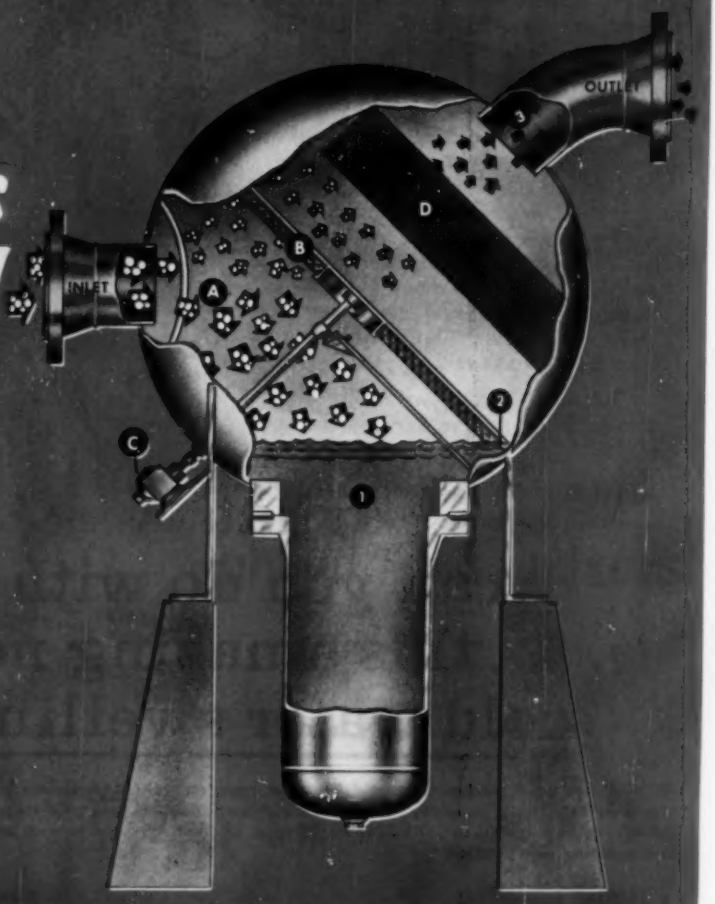

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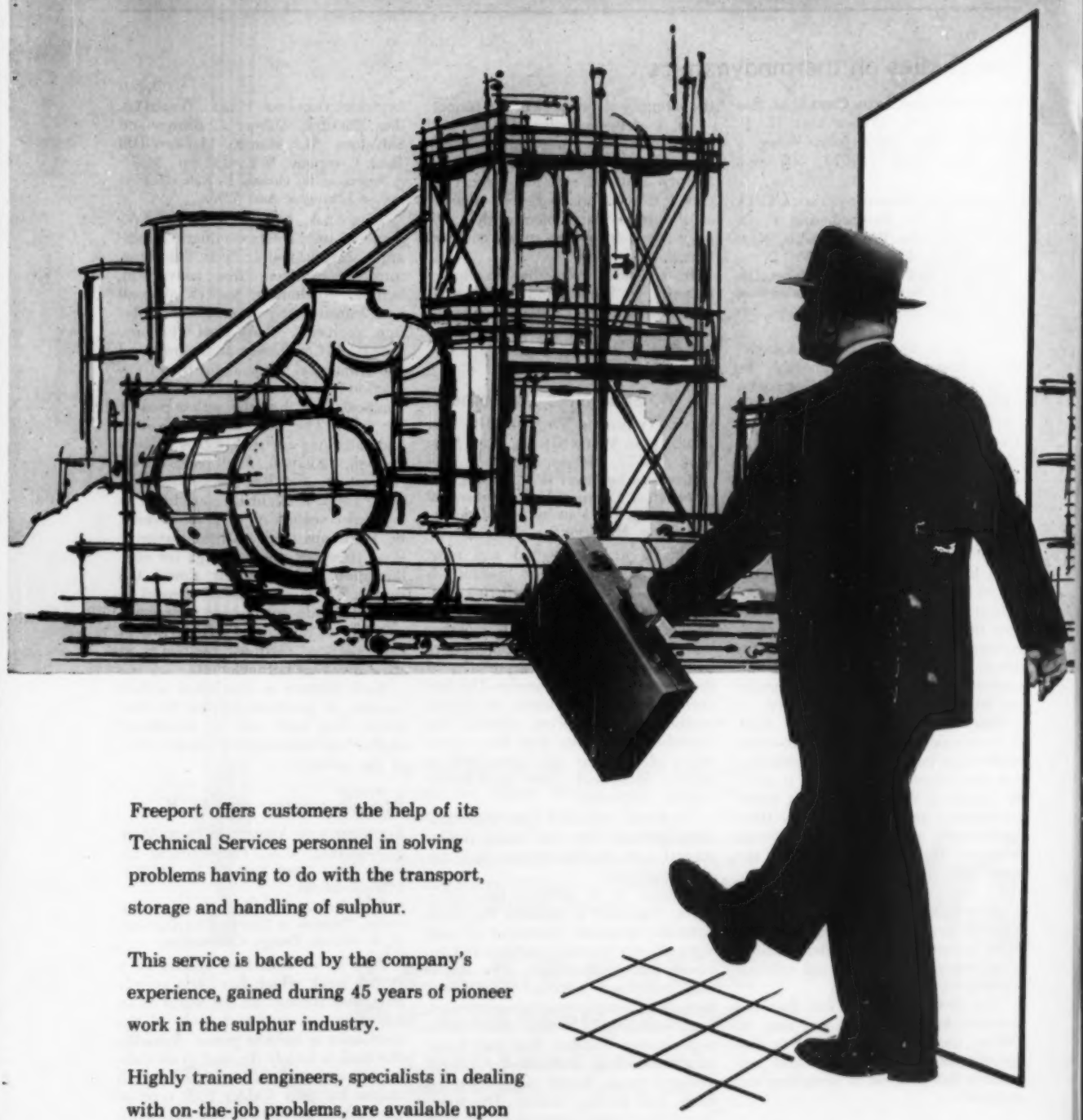

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Two studies on thermodynamics

THERMODYNAMICS FOR CHEMICAL ENGINEERS, H. C. Weber and H. P. Meissner (2nd ed.) John Wiley & Sons, New York (1957), 507 pp., $8.50.

ENGINEERING THERMODYNAMICS, C. O. Mackey, W. N. Barnard, and F. O. Ellenwood, John Wiley & Sons, New York (1957), 428 pp., $7.95.

Reviewed by Charles M. Thatcher, Department of Chemical and Metallurgical Engineering, University of Michigan, Ann Arbor.

This is a need for a thermodynamics text which can profitably be used for review or self-instruction without dependence upon any specific level of prior knowledge in the field. This need has apparently been met in admirable fashion by Weber and Meissner.

The authors' development of the basic thermodynamic principles and relationships is lucid and coherent, and practical applications are emphasized throughout. The liberal use of solved illustrative problems is particularly noteworthy in this respect. Further, the over-all presentation is characterized by a judicious concern for detail, with the result that it should neither bore the well-prepared reader nor hopelessly confuse the novice.

Although the scope of the book is commendable, the cover-to-cover reader may find the order of presentation disconcerting. However, it must be admitted that the obvious interrelationship among the various thermodynamic principles necessitates arbitrary decisions in regard to the most desirable organization of material.

More valid, perhaps, is the criticism that the treatment of specific applications is sometimes concluded without a summary of their general relation to each other.

The sporadic reader will find the nomenclature consistent and easy to follow, and the development in any specific section is complete and reasonably independent of preceding text material.

• • •

In contrast to the Weber and Meissner work the book by Mackey, Barnard, and Ellenwood is almost entirely applications-oriented and includes significantly more descriptive material. The treatment of fundamental principles suffers in consequence, and the latter text has neither the scope nor the intensity of coverage of the former.

As a case in point, Weber and Meissner devote three full chapters, plus a considerable quantity of preparatory material, to the subject of chemical equilibria, whereas Mackey *et al* dismiss the subject with a 10-page treatment which covers combustion only.

In contrast, even the descriptive material in Weber and Meissner is principles-oriented and hence better suited for the reader seeking an understanding of the general field.

An indispensable twosome

HEAT TRANSFER—VOLUME II. Max Jakob, John Wiley & Sons, Inc., New York (1957), 652 pp. $15.

Reviewed by Stuart W. Churchill, Department of Chemical and Metallurgical Engineering, The University of Michigan, Ann Arbor, Michigan.

This is a long-awaited and most welcome book. A debt of gratitude is due S. P. Kezios for completing Volume II after the untimely death of Dr. Jakob in 1955. Volume II, together with Volume I, provides a comprehensive and authoritative interpretation of the literature of heat transfer. The late author analyzes, criticizes, evaluates, synthesizes, and often extends the contributions of the past fifty years. Many derivations are presented in greater detail and clarity than in the original references.

Emphasis is placed upon analytical developments but the more fundamental and significant rate data are also examined.

Volume II is divided into three parts. The first is possibly the most extensive available treatment of radiant exchange between surfaces and between fluids and surfaces. The second part comprises selected applications including temperature measurement, heat exchange between two fluids, regenerative transfer, film and transpiration cooling, and transfer in high velocity gases, liquid metals, packed beds, and cooling towers. The treatments are quite extensive although important omissions can be noted. The third part consists of 31 pages of miscellaneous supplementary material for Volume I. Fifty-five problems are appended.

This volume and the previous one will prove a valuable source book for practicing engineers.

INTRODUCTION TO HEAT TRANSFER, 3RD EDITION, Aubrey I. Brown and Salvatore M. Marco, McGraw-Hill Book Company, N.Y., 332 pp., $6.75.

Reviewed by Donald L. Katz, University of Michigan, Ann Arbor.

This book, employing the A.S.A., nomenclature, treats conduction, radiation, dimensional analysis, fluid flow, forced convection, free convection, boiling, condensing vapors, over-all heat transfer, and applications to design problems. Two final chapters, *Transient Conduction* and *Graphical and Numerical Methods for Heat Conduction Problems* reach a higher mathematical level than the earlier part of the book. The treatment is thorough and satisfying for such topics as conduction, radiation, fluid flow, forced convection, and free convection. In these areas, it might be considered as a simpler version of material covered by McAdams work on heat transmission. However, the coverage for condensation and boiling is almost too simple. These chapters are devoid of figures and do not include such items as effect of tubes in a vertical row in condensation. Pertinent references in these areas are not included.

Each chapter is concluded with a number of problems suitable for students. The book can be considered explicit and informative for many areas of the subject.

Atomic energy and U. K.

ECONOMICS OF ATOMIC ENERGY, Mary S. Goldring, B.A., Philosophical Library Inc., New York, N.Y. (1957), 179 pp. $6.00.

Reviewed by W. Kenneth Davis, Director, Division of Reactor Development, U. S. Atomic Energy Commission.

This is an American edition of a British book which has been widely circulated throughout the world as an objective and unbiased study of the economics of nuclear power. Actually, the book is largely devoted to an elaboration and explanation of the British claims for their Calder Hall type of gas-cooled, graphite-moderated, natural uranium power reactors.

Among other subjects, this volume contains a brief description of the over-all atomic energy industry, a simplified description of atoms, fission, and radioactivity, a detailed history and description of the U. K. atomic

continued on page 36

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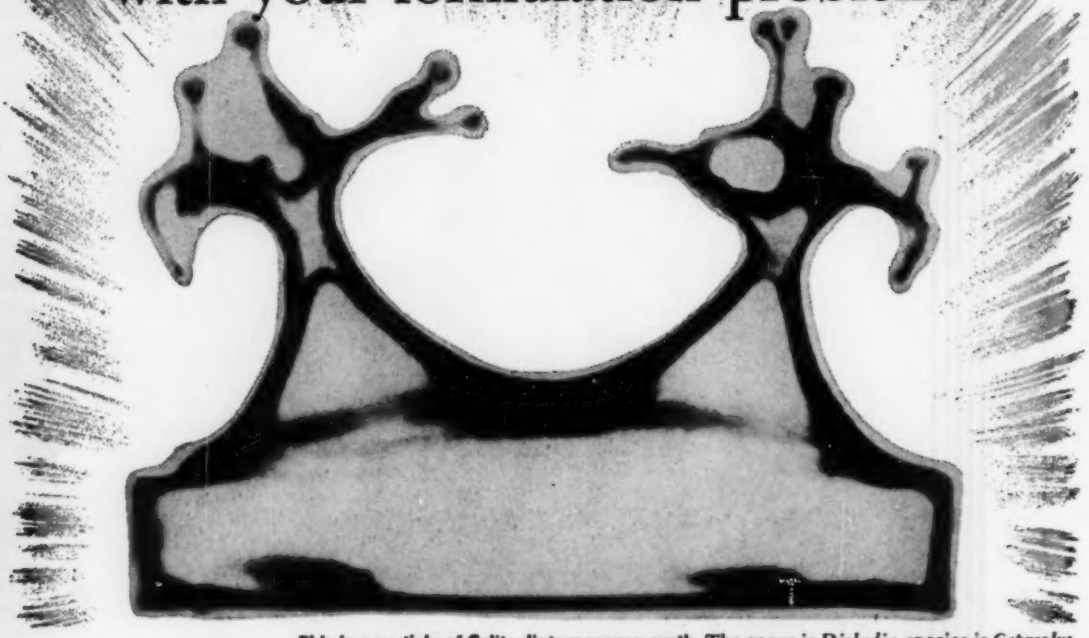

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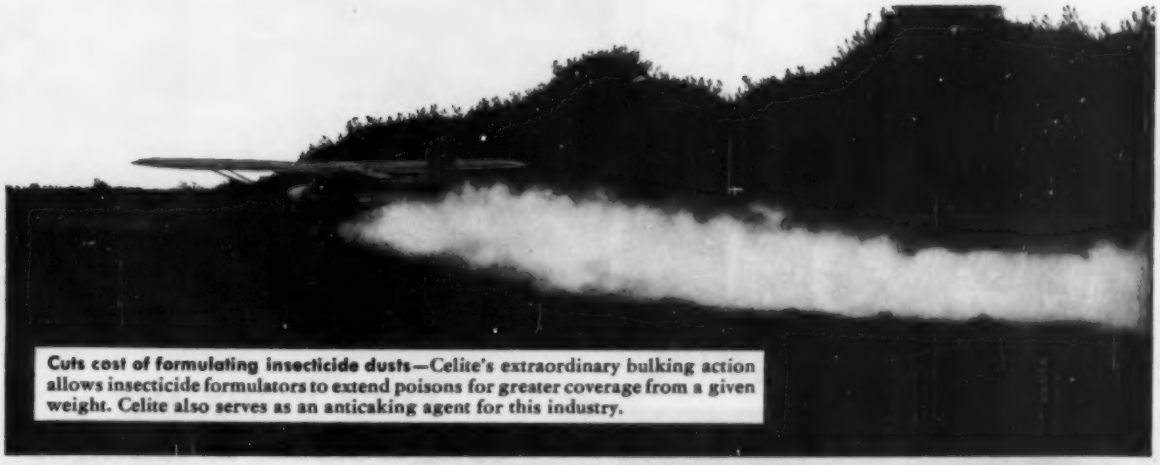

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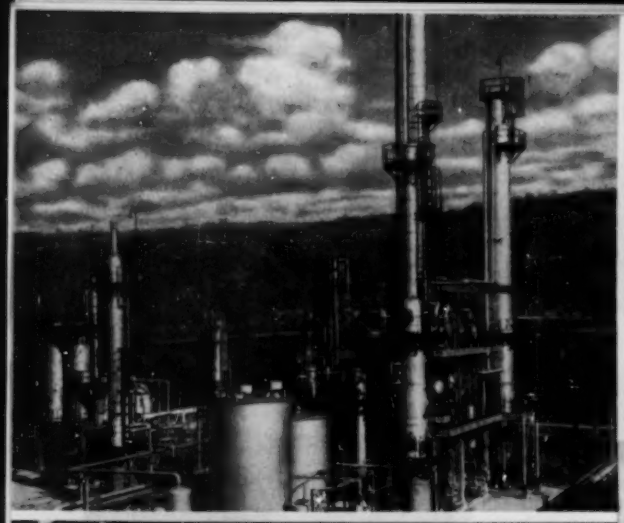

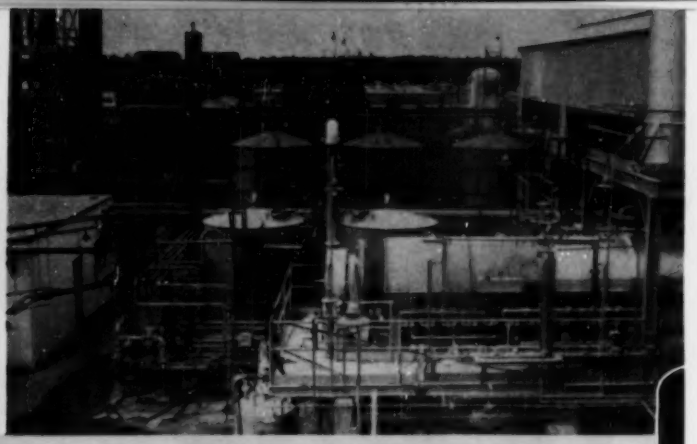

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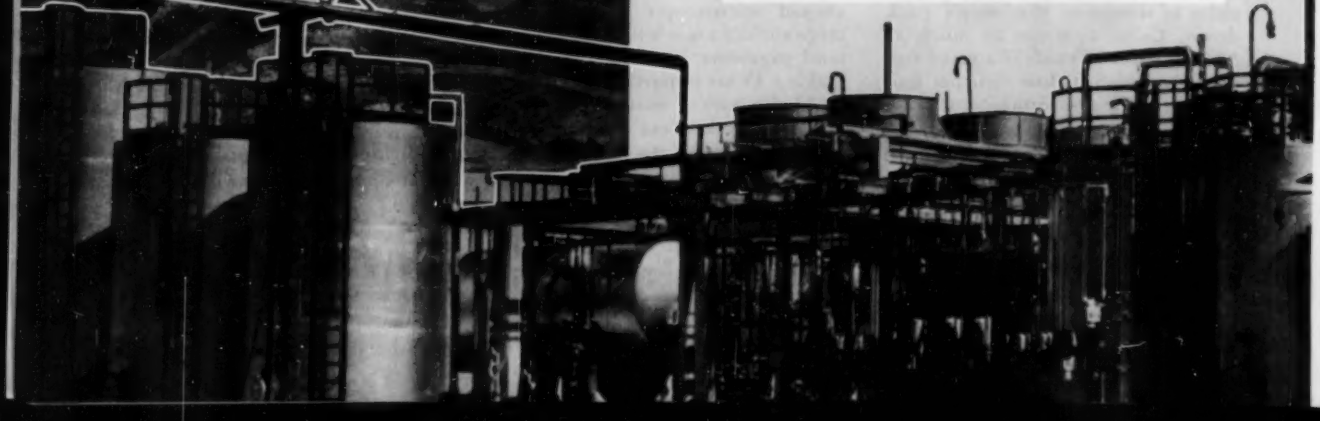

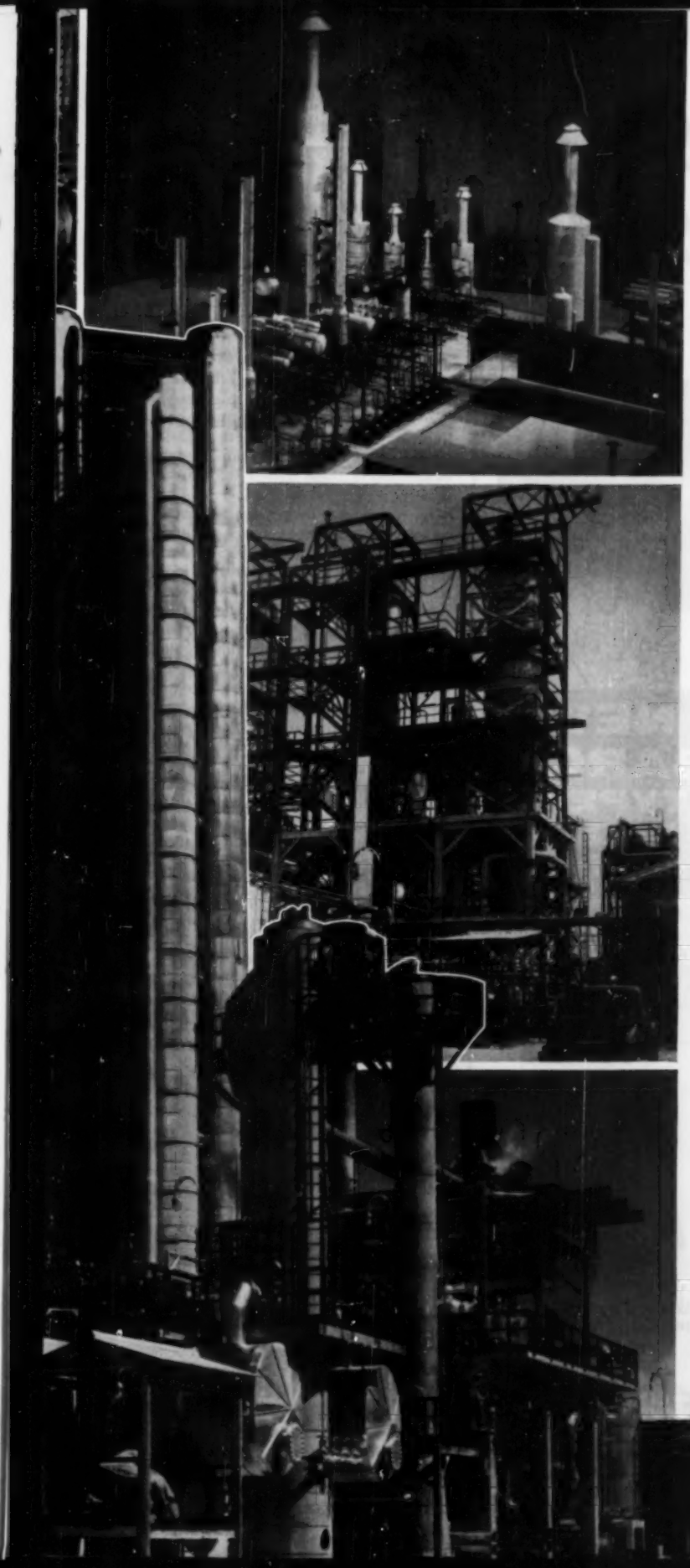

1 Columbia-National Corp., Pensacola, Fla. This plant, engineered and constructed for Columbia-National Corporation, will produce 1,500,000 pounds of hafnium-free Zirconium per year.

2 Jones & Laughlin Steel Corp., Aliquippa, Pa. Revolution in coal chemicals! For Jones & Laughlin Steel Corporation Badger engineers came up with a new process application that eliminates the conventional acid-washing step to produce near absolute pure benzene and toluene.

3 Esso Standard Oil Co., Everett, Mass. One of three current Powerformer projects being handled by Badger. Unit shown is now producing Golden Esso Extra at Esso's Everett, Massachusetts, refinery. Plant was built completely on "stilts" — piles driven deep into tideland marshes.

4 Metal Hydrides Inc., Danvers, Mass. A new plant for the production of Sodium Borohydride, a component of "exotic" fuels. Badger handled the engineering, procurement and construction on this job. Plant was ready in record time even though the process was new and tricky.

5 Cosden Petroleum Corp., Big Spring, Texas. Styrene from gasoline! Ultra-fractionation and other pioneering process developments made this "impossible" plant a commercial reality. On stream in February 1957, the plant produced better than plastic-grade styrene right from initial start-up!

6 Commercial Solvents Corp., Sterlington, La. More methanol facilities. This unit is one of four built in recent years for Commercial Solvents Corporation. Like all methanol units designed by Badger, no chemical purification step is used, yet the product exceeds all present purity specifications.

7 Esso Nederland N. V., Rotterdam, The Netherlands. Model of two process units similar to those being installed in a complete 100,000 bpsd refinery, now under construction in Rotterdam for Esso Nederland N. V. Badger-Comprimo, owned jointly by Badger and Comprimo N. V., The Netherlands, is prime mechanical, engineering and construction contractor.

Other current Badger projects

Propane Deasphalting Unit — Anderson-Prichard Oil Corp., Arkansas City, Kansas • MEK Dewaxing-Deoiling Plant — Atlantic Refining Company, Point Breeze, Pa. • HF Alkylation Unit — Champlin Oil & Refining Company, Enid, Okla. • Sulfuric Acid Alkylation Unit — Chinese Petroleum Corporation, Taiwan, Formosa • Continuous Tar Distillation Plant* — Dominion Tar & Chemical Co., Ltd., Hamilton, Ontario • Powerforming Unit** — Esso Standard Refinery S. A., Antwerp, Belgium • Tall Oil Plant -The Glidden Company, Port St. Joe, Fla. • Benzene Udex Unit-Humble Oil & Refining Company, Baytown, Texas • Tall Oil Plant — Monsanto Chemical Company, Nitro, W. Va. • Methanol Plant — Rohm & Haas Company, Houston, Texas • MEK Dewaxing-Deoiling Plant — Sinclair Refining Company, East Chicago, Ind. • Vacuum Distillation Unit — Sinclair Refining Company, East Chicago, Ind. • Paraxylene Plant — Sinclair Refining Company, Houston, Texas • Xylene Udex Unit — Sinclair Refining Company, Houston, Texas.

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marginal notes

from page 30

energy program, particularly the Calder Hall reactors and the U. K. plans for building nuclear power plants, and brief descriptions and histories of the nuclear power programs in several other countries including the U. S.

The economic aspects of nuclear power are largely covered in terms of the scale of investment in atomic energy in various countries, the need for power, and the cost of atomic power. A large number of published figures are included but there is little or nothing in the way of analysis or evaluation of these figures that might be expected in a book on economics of nuclear power. In fact, except for the repetition of cost figures such as those presented by Sir Christopher Hinton, there is little in this book which really deals directly with the economics of nuclear power. There is no discussion of the significant factors in the future cost of nuclear power, the importance of fixed charges and operating practices, the differences in costs between countries, or other matters of critical importance in an objective examination of the economics of nuclear power.

There is a good deal of argument in support of the advantages of natural uranium as a power reactor fuel which is somewhat surprising in view of the announced intentions of the U. K. to utilize enriched fuels in their future power reactors. This reviewer finds objectionable and misleading the statements that the U. S. prices for enriched uranium and heavy water are subsidized and that any countries planning to use such materials from this country should be prepared to pay higher prices at a later date. It is also stated that the U. S. offers of fuel always have "strings" attached which, it is implied, is not the case in U. K. offers of assistance. Any U. S. cost estimates which are quoted are categorized as being "optimistic" as compared with the realistic British estimates.

Inevitable hand of the law

LEGAL PROBLEMS IN ENGINEERING, Melvin Nord, John Wiley & Sons, New York (1956), 391 pp., $7.50.

Reviewed by J. T. Costigan, Member A.I.Ch.E.

From the point of view of a chemical engineer, the substance of this well-written textbook is useful but it does not apply particularly to any legal chemical engineering problems

continued on page 38

Why a Steam Trap Has to Handle "Air"

Low temperatures and corrosion of equipment are often evidence of inadequate trap air venting capacity

Air, with its load of oxygen and carbon dioxide, has an unwholesome habit of interfering with the efficiency of steam heated units. If steam were always free of these undesirable companions, things would be a lot simpler for men-who-operate-plants. Because it isn't, three unhappy situations frequently occur:

1. ***Operating temperatures are subnormal.*** This is a two-part problem. First, an air-steam mixture has a lower temperature than pure steam at the same pressure—see Table A. Secondly, air can "plate out" on heat transfer surfaces as shown in Figure 1. Under some conditions, such an air film will knock down heat transfer efficiency by as much as 50%.

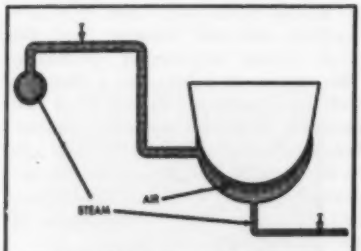


Fig. 1. *How air can "plate out" on heat transfer surfaces. This "insulation" drastically reduces heat transfer efficiency. Armstrong trap operation creates turbulence in the equipment that prevents this.*

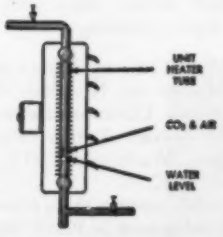


Fig. 2. *Corrosion occurs when units are not kept continuously free of both condensate and air. Armstrong traps discharge both,* at steam temperature, *as fast as they accumulate.*

2. ***Corrosion rears its ugly head.*** Oxygen and carbon dioxide are real trouble-makers. CO_2 gas goes into solution in condensate, forms carbonic acid and chews away at vulnerable metal sections. O_2 aggravates the situation. See Figure 2.

TABLE A—How air reduces steam temperature.

Gauge Pressure	Temp. of Steam with No Air Present	Temp. of Steam Mixed With Various Amounts of Air (% Air by Volume)	
		10%	30%
10.3	240.1	234.3	220.9
25.3	267.3	261.0	246.4
50.3	298.0	291.0	275.1
75.3	320.3	312.9	295.9
100.3	338.1	330.3	312.4

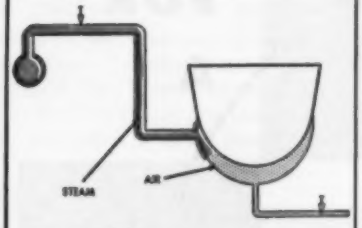


Fig. 3. *When steam is turned on, it takes a trap with extra air venting capacity to provide fast heat-up.*

3. ***Heat-up is slow as a snail.*** Air has a picnic in units that are shut off periodically. Figure 3 pictures the problem. Lines and equipment literally fill up with air. When the steam is turned on it can get in only as fast as the air gets out.

Enter Steam Traps

Curing these steam system ailments involves an operation sometimes called a "trap transplant." It consists of removing traps that don't get the air out and replacing them with traps that do.

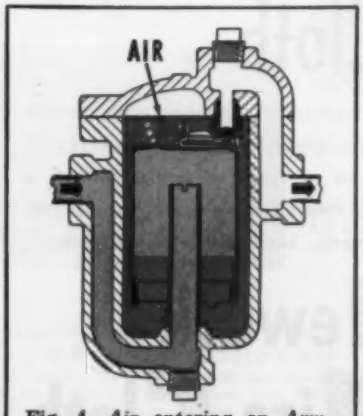
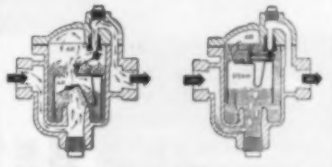


Fig. 4. *Air entering an Armstrong trap passes through the bucket vent and accumulates in the top of trap. When trap opens, air is discharged along with condensate.*

Figure 4 shows how an Armstrong inverted bucket trap continuously vents air. What the picture doesn't show is a built-in plus-value of this trap's design. An Armstrong trap opens suddenly, creating a momentary pressure drop and turbulence in the unit being drained. This breaks up air films and "pumps" air down to the trap so it can be vented.

The vents in standard Armstrong trap buckets will pass all the air normally encountered. In special cases, such as paper machine dryers, the vents are correctly sized larger at the factory to meet the requirement.



Thermostatic vent open. *Thermostatic vent closed.*

Fig. 5. *Open float with thermostatic vent for off-and-on units. When trap is cold, vent is open, permitting air to blow through when steam is turned on. When steam reaches trap, heat closes thermostatic vent. Then, regular bucket vent handles all air coming in with steam.*

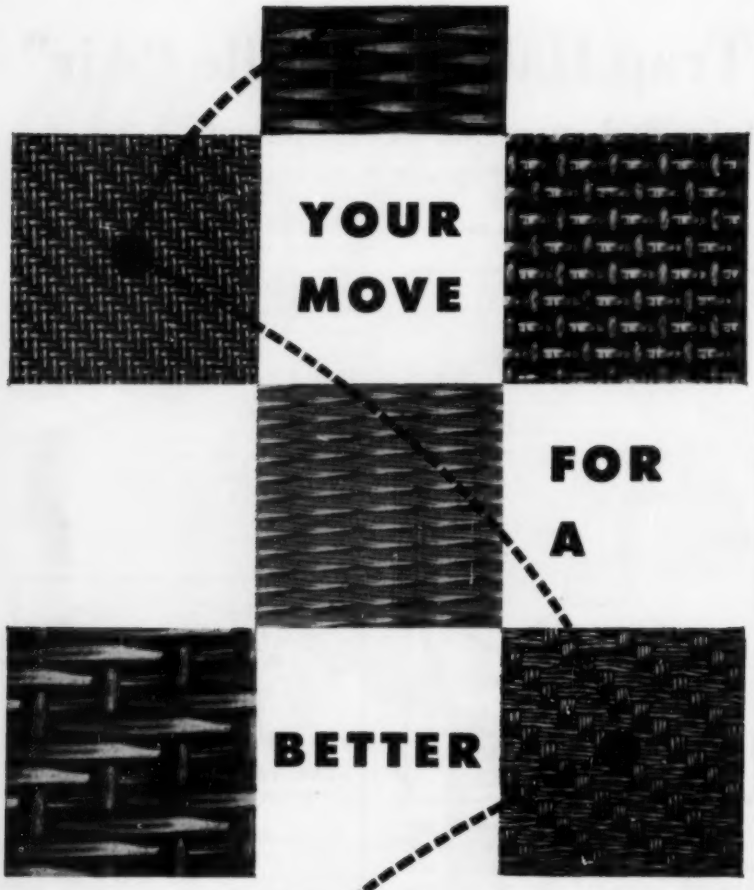
Open Float with Thermostatic Vent

Super air-venting capacity is a must for fast heat-up of low pressure unit heaters, heating coils, steam headers and other units that are on-and-off. Figure 5 shows how the Armstrong open-float-with-thermostatic-vent trap takes care of this.

* * *

The 44-page Armstrong steam trap book covers other features of the Armstrong trap as well as its excellent air handling characteristics. This catalog also discusses trap selection, installation and maintenance. Your local Armstrong Representative or Distributor will be glad to give you a copy. Call him, or write Armstrong Machine Works, 9762 Maple Street, Three Rivers, Michigan.

ARMSTRONG STEAM TRAPS



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marginal notes

from page 36

as such. The only type of engineering that is really recognized in any detail is civil with a little mechanical. The book would be of more use and much greater interest to chemical engineers if it dealt with such subjects as the guarantees inherent in the sale of process equipment and also the possible liabilities and rights resulting from the installation or operation, or purchase or sale of a chemical engineering process.

The work is divided well into four parts. In the first part the author tries to put engineers and lawyers in the same category by calling lawyers "social engineers." This part, covering only a few pages, deals lightly with the basic fundamentals of law and seems a little too compact to be helpful.

The second part goes through the legal principles with which engineers are mainly concerned. Cases cited are carefully selected because they do cover actual engineering problems. The review of labor law I thought well done because it traced labor law generally from the first labor protection legislation of about 100 years ago to the present. This background is important in considering industrial organizations and construction problems of the present day.

The third part of the book having to do with the professional problems of engineering covers largely the code of ethics and data on professional registration. It is, of course, useful as such. To teach ethics in ten pages is difficult. On the other hand, it does set forth the mores of our engineers and of our times.

The last section deals with engineering legal problems.

PRODUCTIVE USES OF NUCLEAR ENERGY. REPORT ON NUCLEAR POWER AND ECONOMIC DEVELOPMENT IN BRAZIL. S. H. Robock. National Planning Association, Washington, D.C., 126 pp. (1957), $2.75.

This work covers the recent economic development in Brazil, the electric power situation there, the future of nuclear power, the programs and problems in the nuclear energy field, and steps toward construction of nuclear power plants.

MOTIVATING FACTORS IN ENGINEER EMPLOYMENT (in 3 parts) Deutsch & Shea, N.Y.C., 58 pp. $7.50 the set.

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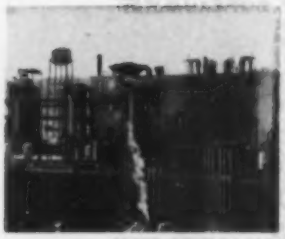

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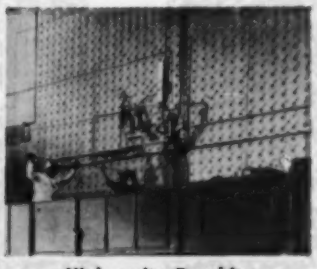
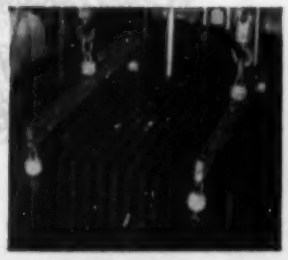
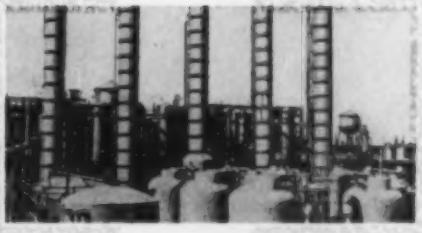


High-purity Graphite for Nuclear Applications



Carbon and Graphite Anodes for Electrochemical Applications

Activated Carbon for Adsorption Applications



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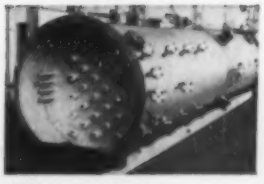
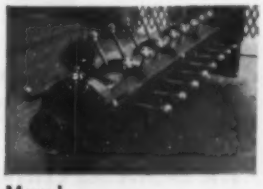
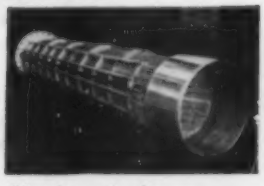


Stainless steel...
Was used in this instance to fabricate a bubble cap tower



Monel...
Another special alloy was employed in the manufacture of this complex reactor



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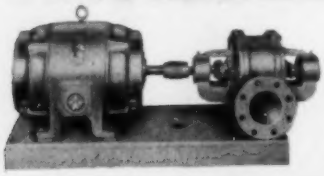

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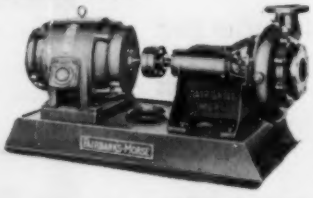

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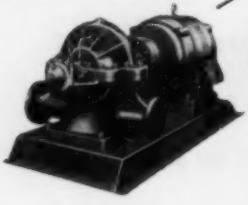

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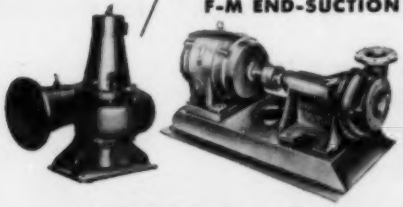

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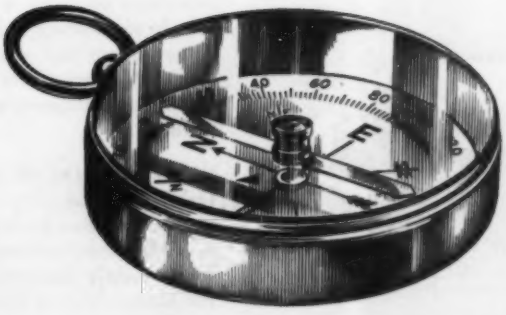

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Chemical Harbingers Of Economic Spring?

While the cold wet weather of this year's late spring, especially in the south, had an appreciable effect in delaying sales of agricultural chemicals, notably mixed fertilizer and ammonia, big makers of ammonia are hopeful that they will catch up on sales in the June quarter, and the farm outlook on the whole is cheerful. Farm income is rising, according to government reports, and is expected to rise further.

This is one of the few cheerful signs in an economy otherwise permeated by gloom.

However, in the general bleak business picture, there are a few other signs of robins appearing as possible harbingers of better times. They may be brutally frozen out, but these few little brighter spots should be watched for signs that the recession or slump may indeed be moving along the "bottom of the saucer," and that things, while bad, are presently not getting sharply worse. This does not mean that an upward turn is around the corner, but if business moves along on a flat level it will encourage hopes that the depression will not be very deep.

Down but not discouraged

Sales of the leading chemical producers, Union Carbide and Du Pont, for example, were down sharply in the March quarter—running around 15% below sales a year ago. However, at the annual meetings of these companies their presidents told stockholders that they hoped for better results over the balance of the year. Crawford Greenewalt, president of Du Pont, for example, said that he hoped that for the full year sales would drop only 5% below 1957 level.

Morse Dial, president of Union Carbide, said that the firm's management believes that present conditions simply represent a short-term readjustment which will not affect to an important extent the long-range growth of the industry. Some of this may be whistling in the dark, but chemical managements in the past have not been prone to rash or overoptimistic statement.

Certainly confidence in the long-range future is undiminished. Du Pont plans to increase expenditures for new plants this year to $240 million from $220 million. Union Carbide will not spend quite as much as last year, but will still spend a hefty $150 million for new facilities. One interesting point in Union Carbide's figures indicating that the chemical business may not be as sick as it looks, is that although over-all sales were down 16% in the March quarter, most of this was caused by the drop in ferro alloy business to the steel industry.

The brightest spot in the business picture of course has been the drug industry, which not only showed record earnings in 1957, but continued to climb to new and higher levels in the first quarter of this year, expects rather startling advances in income for the full year 1958.

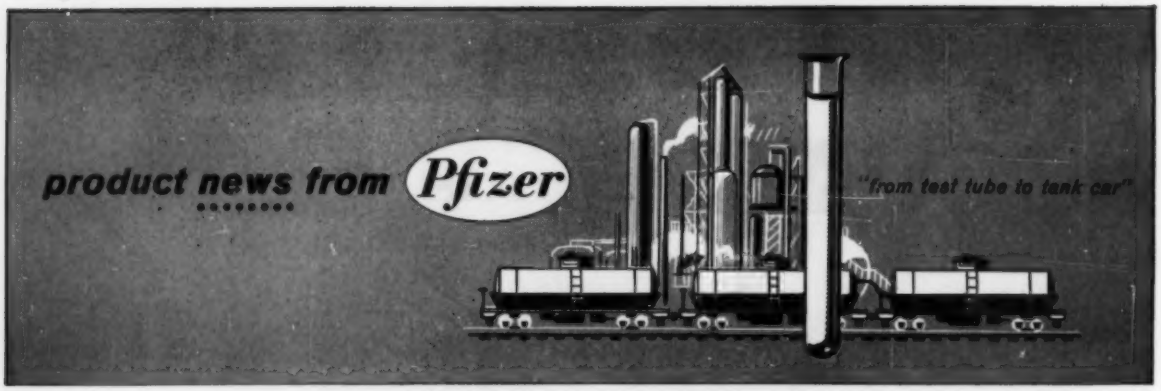
Business news in April was, of course, very bad. Steel operations continued below 50%. Automobile production dropped again accompanied by more plant shutdowns and layoffs.

Other commodities also have been weak. Wool prices for example declined. Nylon business on the other hand looks somewhat better, with Chemstrand increasing its rate of operations and taking back laid-off employees. This is an indication that the long depressed textile business may turn a little better, one of the few bright spots that should be watched. Another small bit of cheer is that big General Electric Co. had an increase in incoming orders in March.

More money, less spending

Meanwhile consumer spending has been holding up very well, and retailers on the whole are not as yet downhearted. Personal income, as a matter of fact, is running at a rate higher than a year ago, or about $341 billion against $340 billion. In other words, there are still a lot of people who have money to spend even though they are not spending it for cars and washing machines. Although unemployment is up to 5.2 million from 2.8 million a year ago, employment is down only 1.5 million.

Congressmen who returned to Washington after communing with voters seem less inclined than before to take drastic measures that might result in out-and-out inflation. Many of them reported, what seems to be confirmed by the figures, that incomes are still high although people are sufficiently concerned about the outlook to cut down on their spending and to put money in the bank. They did not even find much pressure for tax reductions among the people back home. All of this might seem to indicate that caution, not poverty, is one reason for the setback, and when signs appear that business is stable, a turn around could come very fast.



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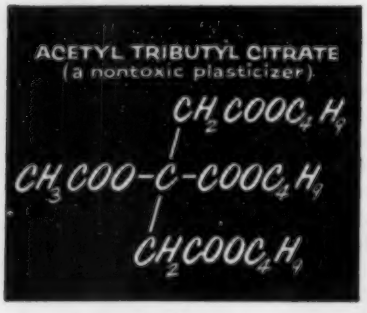

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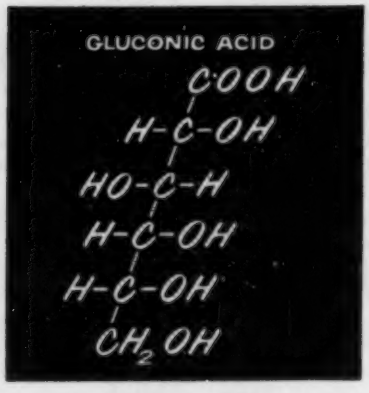

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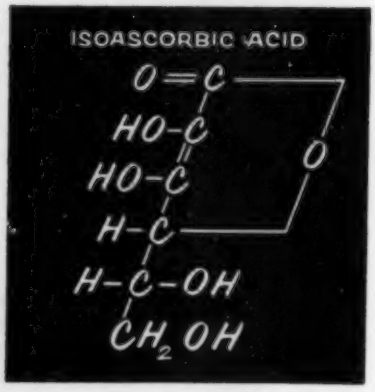

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opinion and comment

A VITAL WORLD FORCE

SOON, THE CLOCK will have turned to an hour marking the completion of a fifty-year journey, and the moment of our Jubilee will be upon us. Chemical engineering will have reached an important milestone, one of which members of the profession everywhere can be justly proud.

With the founding of the Institute during the afternoon of June 22nd, 1908, the chemical engineering profession also came into being. A major accomplishment of our founding fathers was to justify the existence of, and establish, chemical engineering as a discipline deserving its own professional status. In the process of doing this, the charter members frequently expressed their hopes of the future accomplishment to be expected of the new society. Looking back over the years, it seems fitting to give thought to at least one aspect of how well the profession has lived up to these early aspirations.

In contemplating the question of, "What has the chemical engineer achieved?" it is interesting to consider it in the realistic light of today's international race for successful demonstration of scientific achievement.

On the world scene, our nation has been, since Sputnik-I, scientifically on the defensive much of the time. It is not the intent of this writing to minimize the gravity of the problem as it is seen and interpreted by our leaders. Instead, it is to call attention to an area of accomplishment which our Government, in its seeming preoccupation with "science" in a theoretical sense, has overlooked.

This area of accomplishment is that of American chemical engineering. Today, chemical engineering, as developed largely in the United States, is widely accepted by the leading technologists of other nations —even the Soviet Union—as being a powerful and peaceful force for the improvement of the living standards of peoples. They are taking rapid strides with the full cooperation of American chemical engineers, the private chemical engineering industry, teaching institutions, etc.—with the full knowledge and consent of our State Department—to adopt our philosophy and techniques. What a powerful force for betterment modern chemical engineering is! What a story of American scientific achievement.

Under such circumstances, would it not be fitting if our Government were to, with pride, tell and re-tell it to people everywhere? Would it not be fitting for more chemical engineers to be induced into "help the underdeveloped country" project work? Would it not be fitting if chemical engineers were to be appointed to scientific liaison posts said to be unfilled in major embassies?

To the end of each doing what he can to help bring credit and distinction to his profession, one might consider these words of founder-philosopher McKenna, who, at the meeting in 1908, said:* "You who call yourselves chemical engineers, who know the science and the art, who feel your potency and your latent forces, you are to blame if you do not demand to be heard, to show by your efforts what stock you came from, and to demand of educators that in the future the title of chemical engineer be clear, the training adequate, and the public encouragement be the strongest. . . ." J.B.M.

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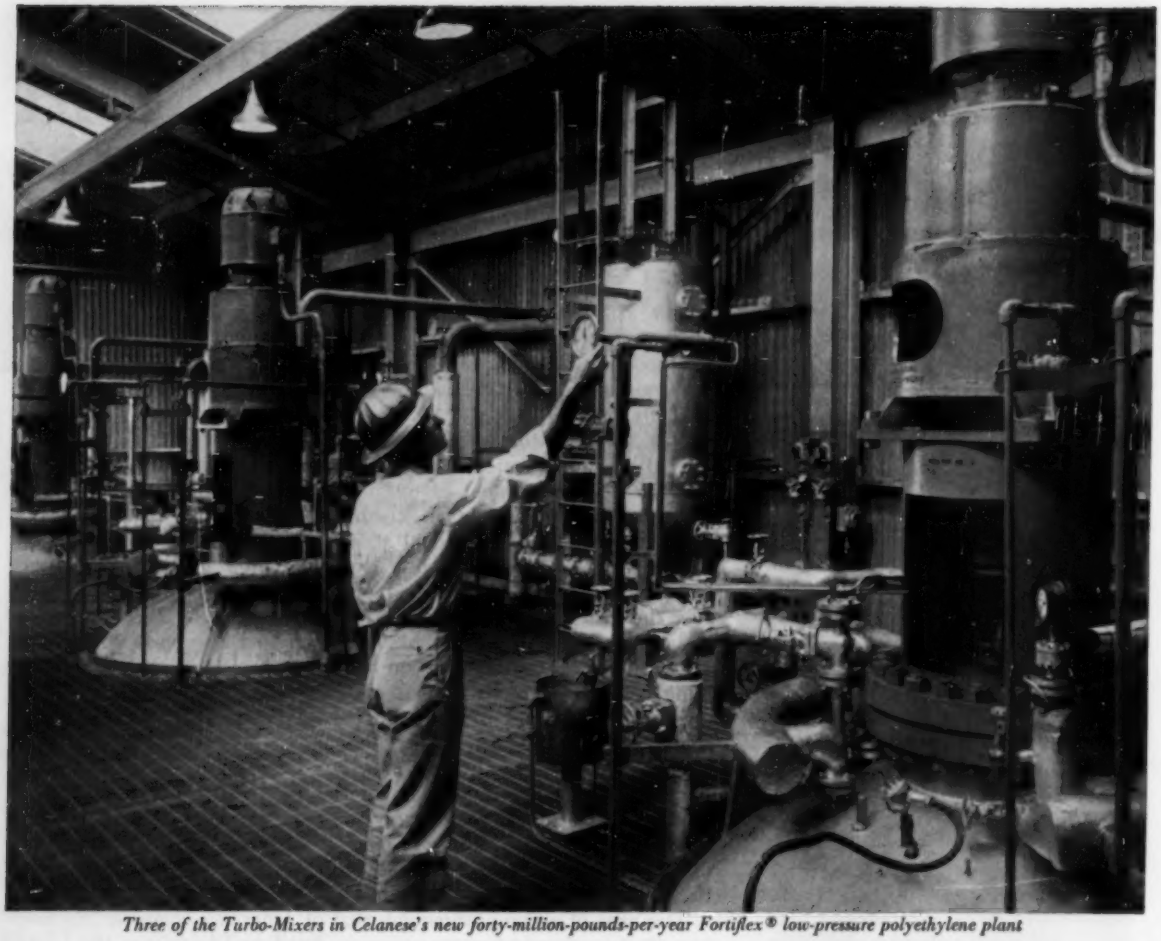
* *As quoted from page 60 of this issue.*



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for critical low-pressure polyethylene reactors,

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For this reaction, Celanese engineers had to have a mixer that would exactly maintain the correct mixing environment. For this reliability in design and performance, Celanese selected Turbo-Mixers. The above-pictured reactors are in the full scale plant (not the pilot plant). Turbo-Mixers serve in many operations in this and other polyethylene plants.

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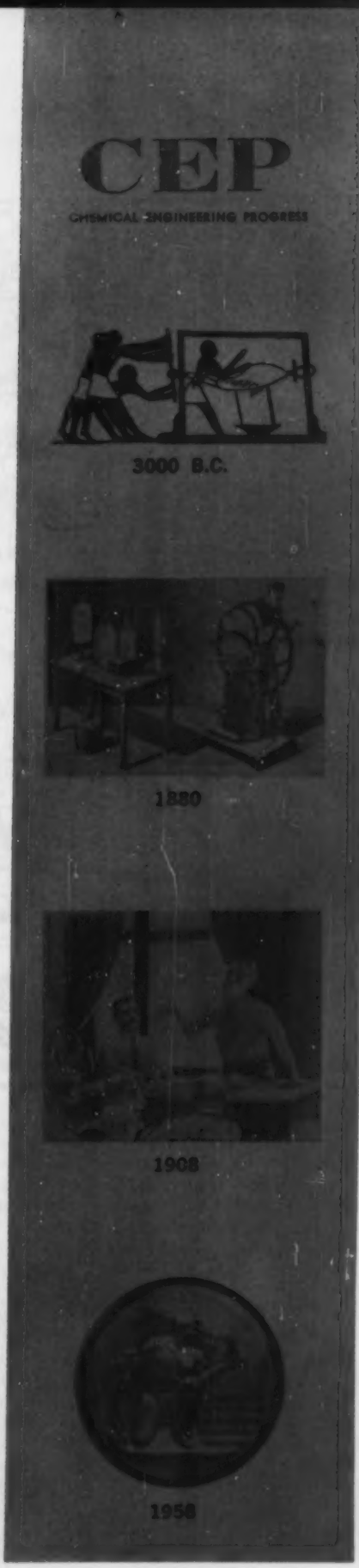
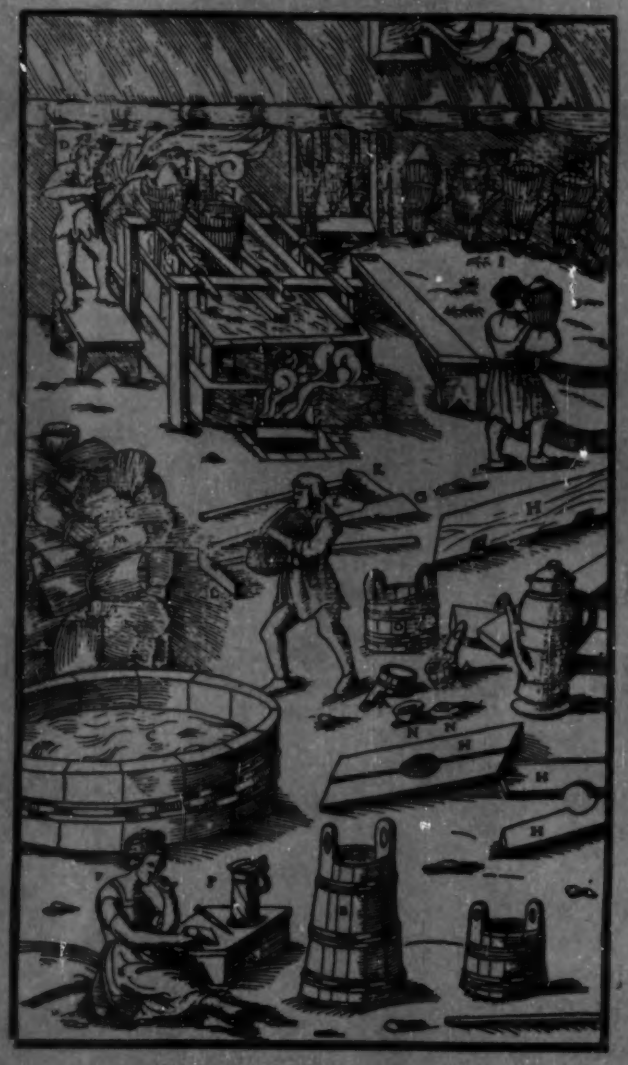
OUR PROFESSIONAL HERITAGE

A great and noble profession came into being when the American Institute of Chemical Engineers was founded in 1908. As is the case with any such historic event, it represented the culmination of the efforts and the imagination of many individuals. In the next twenty-eight pages, CEP endeavors to re-create some of the most significant events and factors contributing to the establishment and growth of the profession . . . and the Institute . . . to the present, and with a brief excursion into the future.



Top to bottom—**Egyptian bag press,** of type used for 2500 years. From tomb wall. Courtesy M. Amin Mandil, Faculty of Engineering, Alexandria. **Gas liquefaction,** from an old print. **Founding of A.I.Ch.E.,** a new drawing. **Medallion,** commemorating Jubilee.

. . . from centuries of practical empiricism . . .



The earliest recognition of the idea that chemical engineering processes could be reduced to a series of unit operations appears in Paracelsus' book Von Naturlichen Dingen *(1527), which said: "Now, transmutation is that a thing . . . no longer appears like its original substance, a different being, a different color, a different power, a different nature or property. . . . It is necessary to know the degrees and steps of these transmutations. . . . These are: Calcination, sublimation, dissolving, putrefaction, distillation, coagulation, and coloration. Whoever now shall ascend and pass these seven steps, he shall come to such a wonderful place that he shall see and experience many secret things in the transmutation of all natural things."*

Above: *Manufacture of salt. Evaporator pan is fired by straw; large tub contains brine. Small tubs contain bullock's blood (coagulated albumen adsorbed the floating impurities of the brine), and stale beer (for "striking" the crystal grains).* From Agricola, p. 472. Courtesy W. L. Badger.

Chemical engineering's . . .

MODERN chemical industry started with the Leblanc process, initiated in France at the time of the Revolution and introduced into England somewhat later. The expansion of chemical industry during the nineteenth century was extraordinary. Moreover, many of its developments were outstanding engineering achievements rather than advances in chemistry itself. The most remarkable illustration is the Solvay process, based as it was on repeated exploitation of the principle of mass action a decade before the principle was formulated and accepted by the chemist, and on the necessity for continuity of operation in a complex system so carefully constructed that material losses were inconsequential. Nevertheless, with the notable exception of Solvay himself (who was trained as a civil engineer), most of the men who achieved these results thought of themselves as chemists—industrial or applied chemists—rather than engineers. Each of them looked upon himself as a specialist in a specific industry rather than as a member of a great professional group united by the possession of common skills and activities.

The historical basis for this situation is easily understood. Among industries of the time that we today would classify as chemical, the most numerous and important were ancient ones, which had developed through hundreds and even thousands of years on purely empirical bases and in which the empiricism had been replaced, up to a century ago, little or not at all. In this category fall ceramics, glass, pigments and paints, soaps, sugar, fermentation, bleaching and dyeing, paper, tanning, explosives, and metallurgy. The historical record indicates little or no intercommunication among these industries and correspondingly limited appreciation of the common elements they indeed possessed. Within each industry the individual operation was looked upon as a mystery, handed down from generation to generation and peculiar to the industry itself. It is, of course, true that by a century ago this situation was changing extremely rapidly in some of these industries, such as metallurgy and explosives; but with an inherent background of ideas derived from the concept of the craftsman's

...EARLY ROOTS

A precursor of chemical engineering is George E. Davis, who tried in 1880 but failed to get his English colleagues to organize a Society of Chemical Engineers . . .

art, recognition of elements common to the various industries was seriously handicapped. This is the fundamental cause of the delay in the development of the view of chemical engineering as a single, unified professional area.

When the demand for top-level technical leadership for the rapidly expanding chemical industry started to develop in the last half of the nineteenth century, the industries naturally began to draw upon the chemical graduates of the universities. The situation was fundamentally different from that which had faced the burgeoning mechanical industries a half century earlier, for they had found no supply of university men trained in fundamental physics. They had had to meet their problem through the apprenticeship system which later developed quite logically into what finally became our modern curriculum in mechanical engineering education. However, it soon became clear that specific training in the methods of chemical manufacture was needed in addition to the basic training in the science. There therefore developed on the continent instruction in **chemical technology.** From the start, this instruction was organized around the specific industries and indeed was in large degree limited to a description of those industries. Chemical education had thus refused to be influenced by the experience of the engineering profession in training men for practical work. There still was an iron curtain between chemistry and engineering.

Despite the importance of the literature contributions of the Hausbrands and the Kuenens to the development of chemical industry and chemical engineering, it is clear that they did nothing to clarify the professional area. The man who did this was an Englishman, George E. Davis.

It is easy for the modern engineer to forget that his profession is only a little over a century old. The earliest engineering organization, the Institution of Civil Engineers of Great Britain, was established in 1828. The engineering profession first came into being when it was recognized that engineering is the art of applying science to the solution of practical problems. On the basis of this definition, G. E. Davis in 1880 tried to get the technical leaders of the British chemical industry to organize as a Society of Chemical Engineers, but they refused. It appears that it was the controversy he stirred up that initiated the establishment of the British Society of Chemical Industry in the following year. It would seem that the chemists of the time looked on all branches of engineering as applied physics and hence on the term engineering as likely to be misleading if applied to themselves. As to the narrowness of the scientific basis of the major fields of contemporary engineering, they were right; even today it is still physics almost exclusively that underlies civil, mechanical, mining, and the then new-born electrical engineering.

What Davis saw, but was unable to get his professional colleagues to see, was that the problems of chemical industry were engineering problems and that their successful solution required the application of the engineering method. He recognized fully the fundamental importance in the area of the principles of physics were no less essential. Davis's first great contribution was his appreciation of the fact that the basic scientific principles underlying widely diverse chemical industries and their operations are fundamentally the same, and that in consequence the professional men in these industries, holding their intellectual inheritance and engineering method in common, constitute a single professional group, which by effective organization could enhance their professional competence and usefulness.

Davis's second and even more important contribution was in the field of engineering education. Because the scientific principles involved are limited in number and the major engineering ways of using them are also relatively few but wide in applicability, the way to train professional leaders for chemical industry is not to emphasize the details of specific industries but to ground the student in the principles and give him effective illustrations of the art of using them. Davis must be given credit for initiating the modern chemical engineering profession.

In 1887 G. E. Davis, whom I have identified as the precursor of modern chemical engineering, gave a course of lectures on chemical engineering at the Manchester Technical School; in 1901-1902 his lecture notes were expanded and published as "A Handbook of Chemical Engineering." Those Manchester lectures, 28 years before the coining of the term, **presented the essential concept of "unit operations,"** and particularly an understanding of its value for education. Furthermore, insofar as the resources of the period allowed, the concept was developed quantitatively. Thus, in the areas of fluid flow and heat transfer, in which information was available, Davis gives equations and data in forms useful to the practicing engineer. In other areas, such as absorption or distillation, it is evident that he omits quantitative relations only because these were unknown to him at the time his lectures and book were prepared.

Davis's text is noteworthy for several other reasons. For one thing, for securing the basic data needed for design of new process and plant, he places emphasis on the value of large-scale laboratory experiment (the precursor of the modern pilot plant, though on a smaller scale), and gives a calculation indicating how results of such experiments may be scaled up to predict capacity of commercial apparatus. He treats in detail certain unit processes, such as combustion and water treating. He includes the elements of thermodynamics as utilized by the chemical engineer. He faces the problem of safety in laboratory and plant. Throughout, he recognizes the wide applicability of fundamental principles to operations which, at first, appear superficially distinct.

Within three years of the first appearance of his book, Davis published a new and expanded edition. In this he mentions the work of Hausbrand and Sorel and includes an elementary treatment of solubility diagrams. Like the first, the second edition was intended for use as a text for students, as well as a reference work for practicing engineers. Also like the first edition its principal weakness is that, even with due allowance for deficiencies in knowledge at the time, it is not adequately quantitative in the areas of process design.—*Condensed from a paper "Evolution of the Unit Operations" by W. K. Lewis, to be presented by A.I.Ch.E. Jubilee.*

In America, the need develops, Meade acts...

CHEMISTS' SOCIETIES were known in America as early as 1792, when a chemical society was organized at the University of Pennsylvania, to be followed by the Columbia Chemical Society in 1811 and the American Association for the Advancement of Science in 1847, both also in Philadelphia. The American Chemical Society stemmed from a meeting of American chemists in the summer of 1874 at Northumberland, Pennsylvania, for the Priestly Centennial.

In a somewhat similar manner the idea of a society of chemical engineers was set before a group of chemical engineers and industrial chemists attending a meeting of the ASTM in Atlantic City on June 21, 1907. The call to the first meeting to discuss organization of the new society was issued by Richard K. Meade, editor and founder of *The Chemical Engineer*, in which he had twice published (October 1905 and March 1907) the editorial reproduced below.

The mining, civil, electrical and mechanical engineers had already been organized and each had a strong national society in this country. So Meade's question, "Why not the American Society of Chemical Engineers?" was indeed pertinent.

At this meeting, Meade reported his feeling that such a society was really needed, and that he had received letters from a number of prominent chemical engineers and chemists, expressing their opinions fully. Those in favor of organization, which made up the most part of the correspondence, felt it should have high standards for admission. Through committees, the new society might solve many problems of engineering chemistry, widen the field of applied chemistry to the point that the chemical parts of chemical plants would be designed by chemical engineers. The interest of the consultant would be furthered by the discouragement of unprofessional practices, and if possible by the elimination of all incompetent and dishonest followers. Education of chemical engineers would benefit through the co-mingling of ideas of professional men with those of teachers of applied chemistry. Analytical methods might be improved and unified through committees. Patent legislation giving the greatest security to the inventor of the chemical process, etc. would be encouraged.

As a result of the interest he had generated prior to the meeting, and the throughness of his survey of opinion as to the objectives of a new society, Meade's contribution was major.

THE CHEMICAL ENGINEER,

RICHARD K. MEADE, Editor.

Editorial Office, Nazareth, Pa.

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NOTES AND COMMENTS.

Why Not "The American Society of Chemical Engineers?"

At the present time, the mining, civil, electrical and mechanical engineers are organized and each has a strong society. Why do not the Chemical Engineers get together and form some sort of an association? The profession is now a recognized one, and there are probably at least five hundred chemical engineers in this country. Schools of chemical engineering have been established at most of our leading universities and technical schools—notably Columbia, the University of Michigan, the University of Pennsylvania, and the University of Wisconsin.

This is an age of specialties, and specialization means concentration. Men of like minds are anxious to meet and exchange ideas. Few papers on chemical engineering are obtainable and information as to the workings of various forms of machinery

NOTES AND COMMENTS

used in chemical works is hard to secure. There is no need for a chemist to work secretly anymore than for civil, mining and electrical engineers. These men meet and exchange ideas to mutual advantage, why should not chemical engineers find profit in a like exchange? Certain details of every process must of needs be kept secret, but it is highly advantageous for inventors and manufacturers (say of filter presses and vacuum pans) to have some means of making the profession aware of their inventions; and, conversely, it is equally of advantage to the chemical engineers of the country to have such information placed before them. Papers upon the management of chemical works and chemical machinery could be read, and track kept of valuable foreign patents, etc.

We believe such a society would greatly further the interests of the profession along another line. Many plants intended for the manufacture of purely chemical products or to carry out chemical processes, such as boiler water purification, sewage purification, etc., are at the present time built by mechanical engineers. In many cases this work could be much better done by chemists with a knowledge of mechanical engineering, than by mechanical or civil engineers who often have forgotten what little chemistry they learned in their freshman year at college. This state of affairs has not been for the good of the manufacturers, as many portland cement mills, paper pulp mills, cyanide plants, etc., will bear testimony. The reason why most concerns have employed mechanical engineers for this work is because they do not properly understand the significance of the profession of chemical engineering. They regard the chemist as a man of test tubes and beakers and "chemical engineer" as merely a high sounding title some chemists have adopted. A national society of chemical engineers could do much to correct this impression and to properly advertise and advance the profession. Cement mills, cyanide works, potteries, oil refineries, acid chambers, fertilizer works, soap manufactories, etc., should all be designed by men thoroughly appreciating the chemical reaction to be performed in each piece of apparatus as well as knowing its mechanical construction.

The chemical engineer is not a chemist who understands mechanical engineering nor a mechanical engineer who understands

chemistry, he is primarily a chemist, a theoretical, as well as a practical chemist, who knows how to carry out on a large scale the reactions worked out in the laboratory. He is a chemist, for example, who understands not only just how fine a material must be crushed to be properly acted upon by a certain solvent or flux but also just what machinery is needed to do this crushing, how to properly install this machine, what power will be required to run the machine, how to transmit this power from boilers to engines and from them to the machine and finally how to bring the uncrushed material to the machine and convey the crushed product away. A society formed of such men could not fail to be of benefit, not only to its individual members, but, also, to the profession at large and to manufacturers the country over. Its membership need not be large, but it should be representative of the profession, and should include no tyros. The requirements for admission should be high and should be modeled after those of the American Society of Civil Engineers or the American Society of mechanical engineers rather than after those requiring only an admission fee. Quality and not quantity should be the motto of the new society where membership is concerned.

This society need not interfere with any of the four societies devoted to chemistry in this country; nor should it detract one iota from their membership. Most men who would join the new society are broad-minded enough to feel that they need membership in the old society as well as the new. The American Chemical Society is and always will be, the great gathering place for chemists of all faiths and creeds—electro-, physical, industrial, metallurgical, analytical, and "what not"—but already we have in this country a society of electro-chemists, and many of the most influential members of the American Chemical Society are also leading members of the Society of Chemical Industry, the Society for Testing Materials, and the Institute of Mining Engineers. Why then should a society of chemical engineers interfere with any of the older societies?

If you are a chemical engineer, write us your views of the matter. Will you help organize such a society? If so, let us have a meeting somewhere and do it. THE CHEMICAL ENGINEER will pledge its support to the movement.

Meade was, according to John C. Olsen, first secretary of A.I.Ch.E., an "outstanding personality whose mind first conceived the need and purpose of the organization, and whose initiative and industry were responsible for its early growth and development."

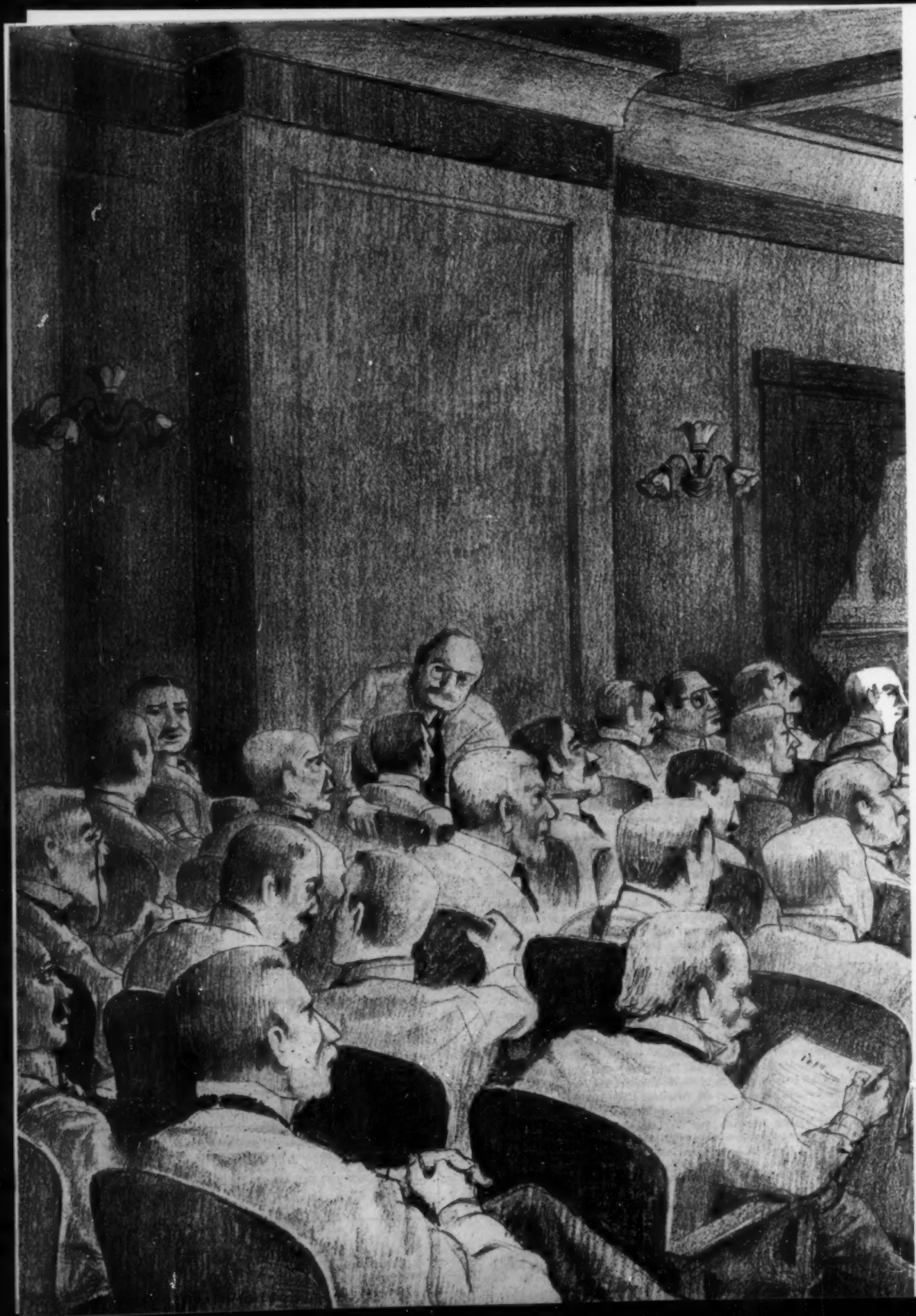
MEADE

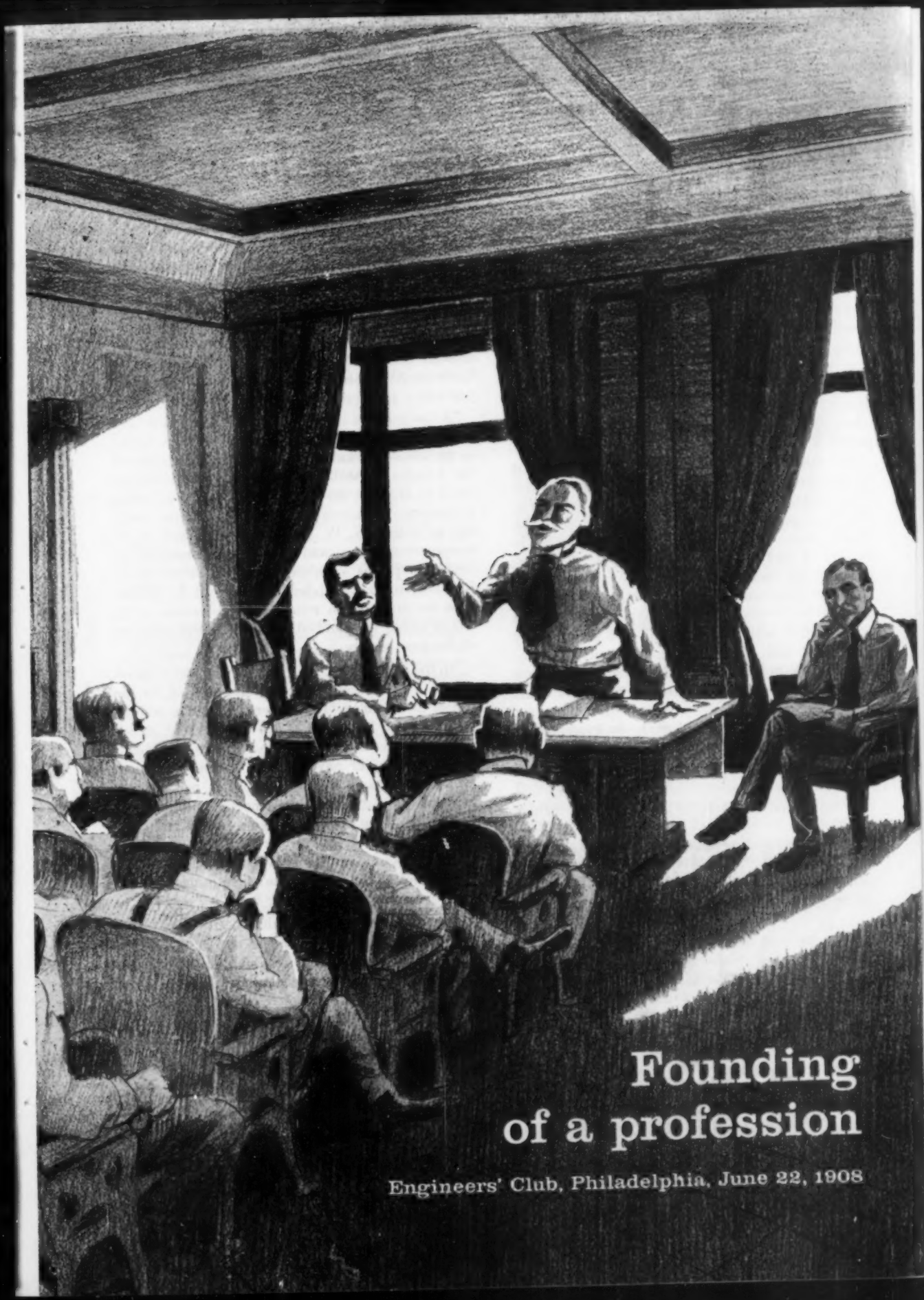
communicator

originator

Through his action, men of similar interests were imbued with a spirit of co-participation in the forming of a new professional society, which would assure distinction to those of greatest ability and adherence to highest professional ideals.

Available at the Jubilee meeting (and later from the Secretary's office) will be a newly issued volume: HIGHLIGHTS OF THE FIRST FIFTY YEARS OF A.I.CH.E., *by F. J. Van Antwerpen.*





Founding of a profession

Engineers' Club, Philadelphia, June 22, 1908

In the re-creation on the preceding pages, Sadtler, as newly elected president, addresses the founding group, while Olsen takes notes and McKenna reflects on the achievement that has just taken place.

Eyewitness account

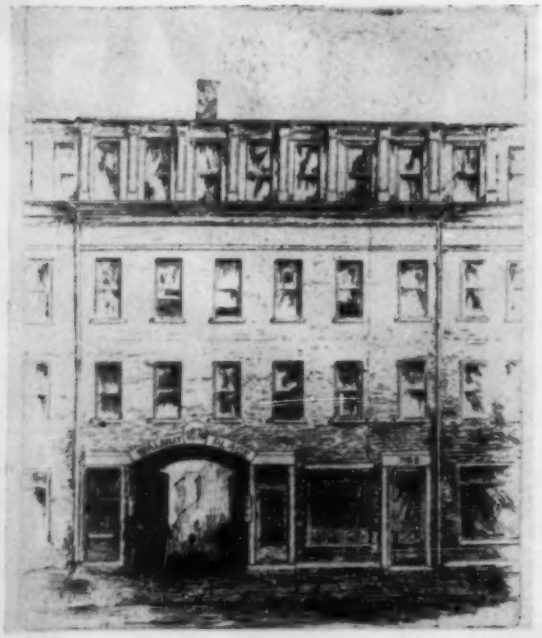
"... it was a hot, humid day...."

"... in Philadelphia on June 22nd, 1908," says Fred W. Dannerth, still-active septuagenarian, who recently described his experiences on that day in 1908 when the Institute was founded.

"I had gone to my consulting office and laboratory at 316 Walnut Street, the same as any other day. Shortly after nine, a visitor strolled through the door, a man I had never met. It did not take long, however, to learn that this was the famous Louis A. Olney, head of the department of chemistry and dyeing at the Lowell (Mass.) Textile School, with whom I had developed a correspondence on current problems and needs.

"We talked a bit, and then I asked Olney, 'What are you doing in town?' He replied, 'I'm here for the organizing meeting of the chemical engineers. It's taking place today, right here in Philadelphia. By the way,' he continued, 'You ought to be in on this.' I told him I had been hearing about the meeting, but because I was only 27, and the minimum age for membership was going to be 30, I felt it would be presumptuous on my part to try at this time to get in with such a group. This didn't satisfy Olney. He said, 'Oh, come on. I'll vouch for you.' Well, a little before ten o'clock I locked up and we took the streetcar up Walnut to the Engineers' Club.

Entrance gate to offices, one of which was Dannerth's. From an engraving dated 1907.



"We went immediately up to the meeting room in the front part of the second floor—a narrow room with theater-like seats bolted to the floor, with the aisle on the right side as one faces the front. There must have been close to forty men there, many of the greatest men in industrial chemical technology. They were engaged in earnest conversation in small groups when we walked in, and I was grateful to Professor Olney for introducing me to everybody present.

"A few minutes later, Professor Olsen from Brooklyn Polytech, a very outgoing type of man, asked us to be seated, and, after a few words, introduced Dr. Charles F. McKenna, who had been doing so much to organize the Institute, and who was acting as temporary chairman. McKenna called the meeting to order. Dr. W. D. Horne was asked to be temporary secretary, and a temporary committee on membership was appointed. This included W. R. Ingalls, Jerome Alexander, and Richard K. Meade. This committee soon retired for deliberation as to whom would be qualified to be the initial members of the new society.

"In the meantime, Dr. McKenna, who was a 'steam engine' kind of a man, handled the meeting for the rest of the morning. He delivered a stirring address justifying the formation of the new society, which seemed to me to just about answer all questions of doubt that might have existed in anyone's mind. McKenna, Meade, and a few others had worked hard for the past year holding meetings, corresponding with leading chemical engineers and industrial chemists, and talking with people. So this morning, McKenna poured out his knowledge and his beliefs, and he did it all with a sense of enthusiasm mixed with dignity.

"Another appointment that had been made during the morning was the nominating committee. To my surprise, Professor Olney proposed my name for this. I quickly explained my concern about my age, but George Adamson (of Baker & Adamson), who was the chairman, said he was in favor of getting younger men into the organization, and so he thought it might be a good idea if I were to serve on the Committee.

"After lunch, we went back upstairs and Dr. McKenna convened the meeting once again. I accompanied the other members of the Nominating Committee into the little anteroom through the door at the left of the meeting room. There we sat around a round table and Dr. Adamson passed out to us

June 22, 1908

a number of 4x5 and 5x7 cards which persons invited to apply for membership had previously filled out. We discussed the qualifications of each applicant quite thoroughly, Dr. Adamson maintaining that we shouldn't be hasty. At one point, after voicing mutual frustration over the answers, 'See Who's Who' written in by a number of applicants, George Adamson remarked, 'What did they think we were going to do, send out for a volume of Who's Who?' Altogether, the Committee meeting took about two hours. Then we filed back into the main room, Dr. Adamson made his report, and the rest is now a matter of historic record.

Fred W. Dannerth as he appeared in 1906 at age twenty-five (above), and (at left) when photographed in the Engineers' Club, Philadelphia, April 3, 1958, at age seventy-seven. (Left center), official minutes of the founding from Transactions.

"At the end of the formal session, groups of friends started to gather and make plans to go out to dinner together at various restaurants. I thanked Professor Olney for his many kindnesses, and, having a great many pressing projects, excused myself.

"It was still hot and humid when I boarded a streetcar and rode back to my office. Walnut Street was bustling with activity, and I had a strange feeling that I had witnessed, and had had a small part in, the formation of a movement that would greatly affect the people in the street that evening.

"Now, today, I look back with great humility at the experience that fate—in the form of Professor Olney—thrust my way. Every aged person is, I suppose, expected to have some advice for younger people. I would say that today, the younger person might do well to shake off the prevalent cynicism towards idealism and formality, and understand the full symbolic meaning of great occasions in his profession. I think one of these great occasions will be the Jubilee meeting this June. I only hope that a good many young people will go away from it as inspired, and with as many fine memories of association with great personalities, as was my privilege—in the same City—fifty years ago today. . . ."

MINUTES OF THE PHILADELPHIA MEETING FOR ORGANIZATION

HELD AT THE ENGINEERS' CLUB,
JUNE 22, 1908.

Dr. Chas. F. McKenna called the meeting to order at 10.30 A. M., and introduced Dr. Samuel P. Sadtler, who welcomed the visitors and spoke of the chemical manufacturers of the vicinity:—explosives, textiles, petroleum refining, linoleum, metallurgical industries, morocco, ammonia and glycerin.

Dr. McKenna was elected temporary chairman, and Dr. David W. Horn, temporary secretary.

Mr. Booth, Secretary of the Committee on Organization, read the report of that committee. Messrs. Ingalls, Meade and Alexander were appointed a Committee on Credentials, and after listening to an address from the Temporary Chairman, Dr. Chas. F. McKenna, reported, recommending that all those present be entitled to a vote as chemical engineers. The report was accepted.

Messrs. Olsen, Grosvenor, Renaud, S. P. Sadtler and Whitfield were apointed a Committee on Constitution.

Messrs. Wiechmann, Adamson, Dannerth, Whitfield and Trautwein were appointed a Committee on Nominations.

Messrs. Ehrenfeld, S. P. Sadtler and Hunicke were appointed a Committee on Finance.

After a short impromptu address by Dr. Hunicke the meeting adjourned until 3 P. M.

AFTERNOON SESSION, 3 P. M.

The report of the Committee on Constitution was then presented by the Chairman, Dr. Olsen. The Constitution was discussed in detail, section by section, and a number of amendments made both in the form of expression and the subject matter. As this was the most important part of the work of the meeting, the remainder of the afternoon was devoted to it. The Constitution as amended was finally adopted as a whole.

The Committee on Nominations reported in favor of the election of S. P. Sadtler, President; Chas. F. McKenna, H. A. Hunicke and E. G. Acheson, Vice-Presidents; Wm. M. Booth, Treasurer; J. C. Olsen, Secretary; R. K. Meade, Auditor; Ludwig Reuter, Thorn Smith and H. F. Brown, Directors for one year; Eugene Haanel, J. M. Camp, C. A. Catlin, Directors for two years; G. P. Adamson, David Wesson, Edward Gudeman, directors for three years, and they were elected.

Dr. S. P. Sadtler then took the chair and addressed the meeting.

It was voted that the bills contracted in organization be assumed by the Institute.

It was voted that the dues for the first half-year (June 1st-December 1st, $7.50) be collected by the Treasurer.

A vote of thanks to the Engineers' Club for the use of their room was adopted, and a vote of thanks to those members who took part in the preliminary organization was adopted. The meeting adjourned to meet at an informal session at 8 P. M., at which time no business was transacted. The Membership Committee was appointed by President Sadtler, and a number of other details were discussed and decided upon. Adjourned.

Here is the substance of McKenna's keynote address made shortly after the opening of the founding session. It summarized his beliefs and feelings after more than a year of work with Meade and others in fathoming opinion and assembling data...

WE ARE HERE to establish a society which shall bring together as brothers a group who have felt themselves to be such, who have been calling to one another to approach, to come under one banner, stand shoulder to shoulder in mutual support, and to enjoy all the inspiration that comes from mingling with one's fellows.

This call has been heard at various times, abroad for twenty-five years and in this country for over ten years past. It grew in clearness and volume during very recent times, and has culminated in the gathering in which we are now so happy to participate. We know it was not without misgivings and hesitation that the answer to this call was first returned, but we are confident now that the misgivings were unfounded and the hesitation unwarranted.

A subject frequently remarked, an opinion held almost unanimously amongst those discussing this scientific society during the past year, is that there appear to be enough such organizations already in this country.

The followers of almost every other conceivable study have some forum, some printed herald to the world, and some mode of representation in the council of these organizations. Every active scientist feels the need of joining the groups with whose aims and ideas he is most in sympathy, and from whom he believes he can find the greatest incentive to his own progress; and, since the sciences have become diffused and intimately correlated, the societies which he feels almost compelled to join are both diverse and numerous. The tax upon him soon becomes onerous in consequence.

It must have been something unusual therefore that the conditions surrounding our profession have led so many of its devotees (in this country) to say, nevertheless, that they felt convinced that a new society was not only desirable, and not unduly burdensome, but was feasible, necessary and unavoidable. The entire body of adherents has been impressed with the glory of the history of our other chemical societies, and proud of their achievements. To the claim that these could provide every service possibly required to advance the interests of Chemical Engineering, they paid due heed. Yet we find among them the demand still insistent for the formation of the independent new society.

There must be something deep and powerful at work in the minds of Chemical Engineers to cause this movement. There must be some force that will not down.

Let us examine the cause closely. Let us consider not only the achievements of Chemical Engineering of today, but also the duty to the nation and to mankind that lies before the Chemical Engineer of the future. Some will say that these are fine words, but that they mean nothing, or at least will lead to nothing. Can this be so when we who ought to know it best are convinced that Chemical Engineering is today, though unrecognized by the public, performing the greatest feats of economic salvation in the treatment of raw materials in the production of staples and by-products?

Is it not true that the Chemical Engineer has oftener served the public than the public is aware of, and that he often stands ready to do so without a taker in the market of public life? The President of the United States calls together several hundred men, to begin a study of the conservation of the resources of our country. In the list it is a pleasure to see Dr. Dudley and Professor Bogart, Mr. Ingalls and Mr. Taylor, but elsewhere in the list, or even in the National Conservation Commission since appointed, there is not a Chemical Engineer or a chemist engaged in the treatment of raw material.

The Mayor of a metropolis appoints a committee of experts to advise upon a new building code. There is neither a Chemist nor a Chemical Engineer amongst them.

The president of one of the largest chemical manufacturing companies in the world says in public that he would rather employ the engineer with a smattering of chemistry than the chemist with a smattering of engineering. Instances like this of either ignorance of the existence of a Chemical Engineer or of his capabilities, or deprecation of his rightful place in the economy of affairs, can be multiplied.

Can consideration of the education of the Chemical Engineers of the future be idle words when we know that today half of the waste of effort in so-called scientific work is by reason of imperfect preparation of the scholar so that he confuses the means with the end, does not recognize the best purpose of his own science, and in the practice or the teaching of its applications follows a lowly aim with a restricted view? Whence springs the reproach heard against technical education, leading some to call our school laboratories, boiler-shops, and some to call them brickyards, if it is not the narrowness of teaching which, in essaying to make useful men and call them scholars, spoils the scholars and dulls the useful men? Whence, too, springs the reproach to the Chemical Engineer himself that the public, which he knows he can aid, is not enough acquainted with him to consider him worthy of being called as an adviser of prime importance?

Those who have most closely studied the situation have stated that the Chemical Engineer must be better recognized, that his talents must be better appreciated and oftener used, that his opportunities must be enlarged, his rewards increased, and, above all, his sons and oncoming successors must be better educated.

As to the recognition of the Chemical Engineer, much of a pertinent character has been said during the discussions which we have so actively participated in during the last year. Mr. Stantial's comparison of the Chemist to the cryptogamous plant was particularly happy and explanatory. In all times the alchemist, philosopher and chemist have been men of the study. A bold attack in the

McKenna

the philosopher

His perseverance brought unity and direction to dissident forces . . . His philosophy established the basis upon which the new society was formed.

open, and on a large scale, upon some material in nature was never expected of them. The test tube seldom suggested the digester. Thus, an ideal and broad view of an industry demonstrating its importance, or the bold inventiveness of one who loves to do and dare and is appalled by no obstacle, has meant nothing to the chemist of the closet; and the world took him at his own modest estimate. We have had in history, however, many glorious exceptions; men who, like Chevreul, have come down from the lecture table, gone into the factory, and done the practical work, based on theory, so well that an entire change in an industry resulted. Or men like Castner, who could invent and reinvent and face even the disappointment consequent on the destruction of an industry resulting from another invention at the moment of his own triumph in that industry.

The rule, however, has been that such chemists have been chemists, calling in the hydraulic engineer, the mechanical engineer, or the practical man, as the field of work required, just as they might call in the architect to design the arrangement of doors and windows in the halls in which they worked. Is it any wonder that the demand has come for a change, and that the Chemical Engineer wants the world to know that with his deep-seated knowledge of the reactions involved, and of the properties of raw materials, he also has enough engineering knowledge to design his constructions, make his own hydraulic calculations, and has the ability to make economic and scientific studies whose results may be so far-reaching as to influence commerce and profoundly affect human activities. That the Chemical Engineer will oftener be consulted in the future is a certainty, if for no other reason than the fact that in modern times, and in very recent years, we have seen some conspicuous demonstrations of the disasters caused by the failure to consult him or to yield to his teachings when large commercial undertakings were conceived and carried on in contravention of the warnings of science which were unheeded by engineers whose eyes were fixed only on the plan of construction. Mistakes in selection of site, in choice of raw material or fuel, in supply of water, in mechanical equipment or in treatment of material have been so numerous as to constitute almost an indictment of modern engineering if it were not seen that the fault in such cases is individual.

Economies in conveying or handling can be minimized or even destroyed in ultimate effect if great misconceptions of chemical principles have been allowed to remain uncorrected in furnace or tank or still. I must quote here some very apt and pertinent paragraphs of a private letter from Dr. H. Aug. Hunicke.

"It is realized by those who are practicing chemical engineering that there is such an art. Each has, by years of experience, accumulated knowledge which he utilizes to advantage. Unco-ordinated knowledge may be useful and often does, perhaps, form the bulk of what constitutes a practical art. Facts properly co-ordinated make science, and it is the process of co-ordination of already accumulated facts, and newly discovered ones, which must form the basis of the policy of a society of chemical engineers. A program so comprehensive should certainly justify the formation of a society such as is contemplated, and no better evidence is needed than the fact that it is at this time difficult to impress upon chemists who have never been engaged in work requiring a knowledge of engineering, that there is a world of applied science still awaiting co-ordination to make it a tool in the education

The substance of McKenna's keynote address . . .

continued

of the future generations. Today only those who have been at some time engaged in the solution of problems presented by the industries with full power to assume responsibility of execution or administration, realize the needs, which in a measure it may perhaps still be difficult to formulate, but which have impressed themselves upon the minds of those who are best fitted to judge the situation.

"A section [he says, referring to the proposition of forming a section and having an affiliation in an existing society] would be in danger, by the preponderance of certain elements, of assuming a character entirely foreign to what it should be, and would doubtless result in a mere duplication of existing work.

"I wish to add that I am a little disappointed that no speaker at the Hotel Belmont meeting alluded to a subject which brings out in a most forceful manner the specified differences between chemical engineering and all other forms of engineering. If we define engineering as the art of intelligently applying the forces and materials of nature to the needs of man, we will at once see the bearing of chemistry on one feature of engineering arts, and realize at the same time that it is only the discoveries of the more recent years which resulted in the creation of a new science, that of physical chemistry, and which gave us the scientific principles to create that branch of engineering which has for its object the transformation of matter. In the past, chemical changes were brought about by the strictest observance of conditions of operation, with the ever-present dread that some, perhaps not recognized factor, had been overlooked and thus result in disaster. Modern science is, however, revealing laws which place us in a position to replace the old chemical instinct by clear conception, the direct outcome of our knowledge of the mechanism of chemical change resulting from the application of principles such as the law of mass action, velocity of reaction, equilibria, etc., which define the physical condition which must be fulfilled for the attainment of any desired end. This distinct characteristic of chemical engineering has until recently made it the more important that it should be recognized, because it will, in a large measure, make clear why chemical engineering has until recently been little more than mechanical engineering applied to the chemical industries; but that the day has come when chemical engineering has grown to be something distinct, a province of engineering differing from all others in that it aims at solving problems involving principles entirely foreign to the other engineering professions."

We can see therefore from these words of Dr. Hunicke how the problems that lie before the chemical engineer, and to the solving of which he brings all the new equipment which his own and other sciences have now placed at his disposal, make an array which is fascinating.

Some have said that ours would be a society of "industrial chemists," and as you have several excellent societies already pledged and actively striving to do something for the "industrial chemist," a waste of effort is involved in our action here. But in that argument lies an error which needs only to be pointed out to bring conviction that we are now in the right position. This error is twofold, and lies first in the misconception as to what constitutes the chemical industry, and secondly, in the belief that outside of industry "the Chemical Engineer would have no field of action."

I would like to point out that Dr. Monroe, in his admirable report on Chemicals and Allied Products for the Census of Manufactures, 1905, says that an industry in which materials undergo a chemical change in process of manufacture would have to be considered as a chemical industry.

Based on this definition, there is a vast field for the Chemical Engineer not covered by mere common acceptance of what is conveyed by the term *chemicals*. We would include the great industry of illuminating gas manufacture, coking and by-products; sugar manufacture; corn products; the silicate industries; detergents; and a great array of textile, paper, and leather industries.

Outside of these industries, we have the water works, the fields of advising a municipality, a railroad, or some great aggregation of manufacturers.

A minor plea for the justification of our Institute can be found in the hope of lessening the secrecy which invests much of the creative work of our best Chemical Engineers in this country. It is difficult to estimate the proportion of this which is necessary, unavoidable and not unworthy; but as to what can be eliminated we are all agreed that "let there be light" is a command which, if followed, will be for the good of all and the benefit of our country.

The noblest aim before us, gentlemen, the one which most amply justifies us before all the world, is our ambition for the enlightenment and ample equipment of our successors: that is, for the improvement of the training of the Chemical Engineer of the future. How to design a course in chemistry and chemical engineering I leave to other times and other places; this is not the occasion to go deeply into that, the mere mention of which suggests the greatest variation of opinion among the masters themselves.

I will only ask for fair treatment for the student, and for the young graduate who may not know that he has only just become a student of this practical science. Encouragement should be given to a little "shifting in his jobs" within reason. Frequent transplanting, you know, is good for the root system of the young tree, but only an expert culturalist should oversee it.

We need in the profession a few very deep scholars rather than a number of half-educated ones, or brilliant but superficial interpreters of science.

I said in the opening that we begin as brothers. We inevitably will close our careers as fathers, passing on to our sons in the profession a heritage of knowledge and light that shall increase as the flame increases with the increase of fuel. No man who works for the success of this society works for himself. He can expect no reward other than the pleasure which comes from fostering a worthy cause close to his heart.

You who call yourselves Chemical Engineers, who know the science and the art, who feel your potency and your latent forces, you are to blame if you do not demand to be heard, to show by your efforts what stock you came from, and to demand of educators that in the future the title of Chemical Engineer be clear, the training adequate, and the public encouragement the strongest.

Now all of these aims being noble, being those of yourselves, and so enlisting your sympathies in a special way as can those of the men of no other society, must we not conclude the American Institute of Chemical Engineers has ample justification for existence, and will live, thrive and prosper?

SADTLER

the executive

Chemical industry leader, business executive, professor of chemical engineering, Samuel P. Sadtler brought to the Philadelphia founding meeting the welcome of the chemical industry plus his own great prestige and ability. As a demonstration of his enthusiasm and faith in the new organization, he accepted its first presidency

President, A.I.Ch.E.—1908-09

Other personalities who served the young society

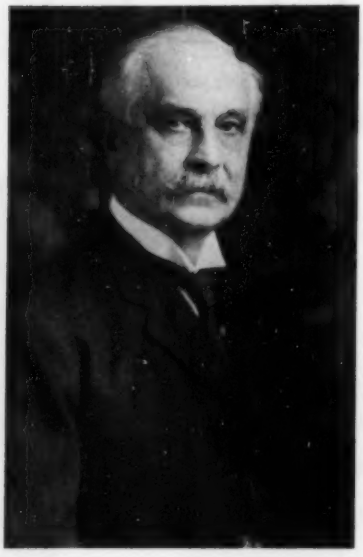
David Wesson
founding member,
original director,
President, 1920-21

John C. Olsen
Chairman, Founding
Committee on Constitution,
Founding member,
First secretary, 1908-1926,
President, 1931

OTHER PERSONALTIES

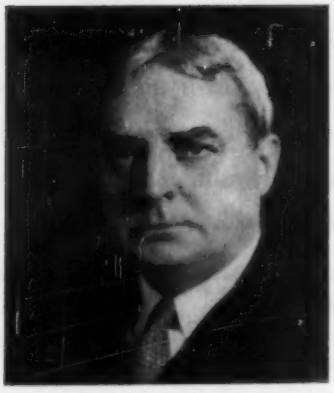
who served the young society . .

Longest a member—Jerome Alexander, an active and influential member for 50 years, shown in his Chemists' Club consulting laboratory in 1906.



F. W. Frerichs, early (1911) president, long (1912-1925) treasurer of the young society which he helped found. Frerichs was elected at the founding session to the first board of directors, serving from 1908 to 1911.

Leo Baekeland, as photographed in his office in 1912 when he was Institute president, and just after his work on Bakelite. He served as a director 1917-19.



Oldest past-president M. C. Whittaker, who held that office in 1914, and was vice-president 1912-13. He has long been influential in professional affairs.

Chemical engineering pioneer, entrepreneur, John Van Nostrand Dorr, shown at left, in a Colorado mining and milling camp, 1910. Later, Dorr served three times as director, twice as vice-president, and became president for two terms in 1932. Recently, he has been active in the planning for the Jubilee Meeting.

William H. Walker, an early strong influence in education, and namesake of the Institute Award, as he appeared in a 1907 publication.

the EARLY SCHOOLS first—a struggle for distinction . . .

M. I. T.

In 1888, the year after Davis's lectures at Manchester, an educational program in Chemical Engineering was organized on this side of the Atlantic at the Massachusetts Institute of Technology. Lewis M. Norton, at that time Professor of Industrial Chemistry, developed the proposal, organized the course and ran it.

The objective of the curriculum was to give: "general training in mechanical engineering . . . the study of the applications of chemistry to the arts, especially to those engineering problems which relate to the use and manufacture of chemical products."

In the early years enrollment per class ran around eight to twelve. Unfortunately, Professor Norton died in 1893, and direction of the program and the instruction in the subjects fell into the hands of men whose primary interests lay in other fields.

The lack of leadership following Norton's death was remedied in the fall of 1902 by the appointment of William H. Walker to head the course. Walker was an experienced and successful consultant to the chemical industry, who had been associated with Arthur D. Little for several years in the firm of Little and Walker.

Walker immediately started the transformation of the chemical engineering curriculum. It was he who at the earliest practicable moment incorporated Noye's course in physical chemistry, as a requirement. His first objective in the chemical engineering instruction was to focus on the underlying principles. His second objective was to make the treatment quantitative.

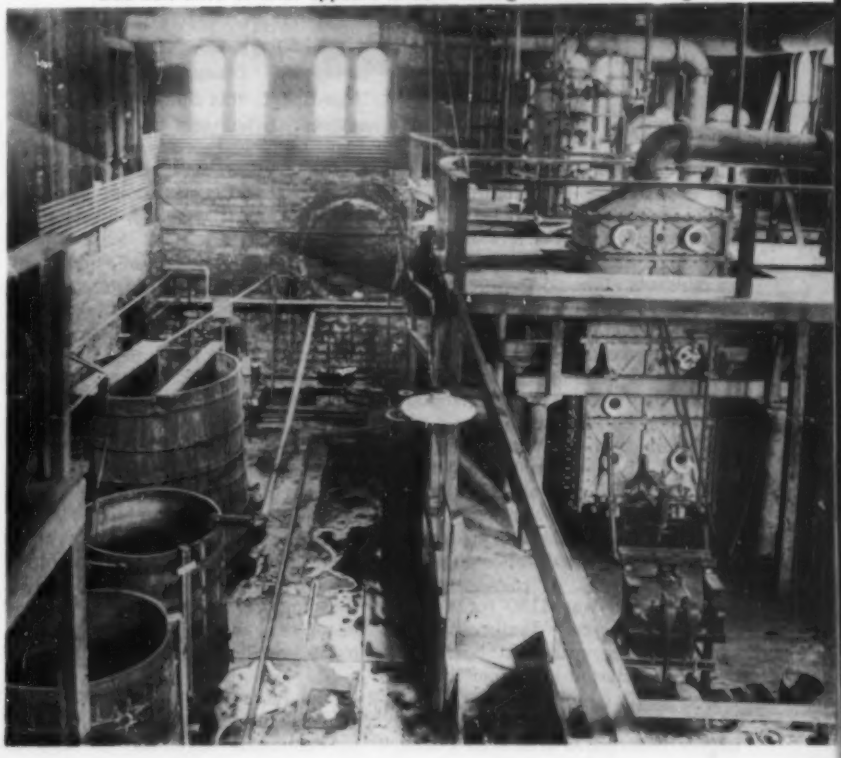
As a curriculum in the catalog these changes were substantially completed in 1907, but the process of approaching the ideals represented by the changes required years of persistent effort.—W. K. Lewis.

PENNSYLVANIA

The University of Pennsylvania announced its curriculum in Chemical Engineering in 1892. This was the second curriculum to be established in the United States, and to a con-

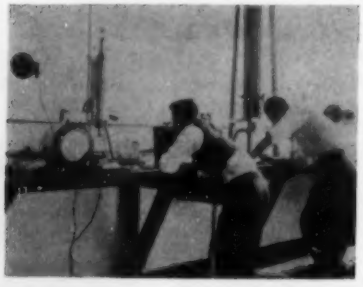
University of Pennsylvania—1910. View of assay room in chemical engineering laboratory.

University of Michigan—1918. Badger's evaporator laboratory, which was in an old powerhouse. Note cast iron construction of unit in center, also belt drive of what appears to be a mixing vessel in the foreground.



EARLY SCHOOLS . . . then a rush into unit operations
continued

Faculty of Chemical Engineering Department. Back: Mead, Atwell, Calingaert, Whitman, Hoops, Robertson, Kunberger, Forrest. Middle: Robinson, Weber, Barnard, Stose, Pitman, Russell, Myers. Front: Youtz, Lord, Lewis, McAdams, Fuwa.



Tulane—1913. View of gas analysis laboratory, Chemical Engineering Department. Note convenient source of raw material—wall fixture!

siderable extent credit for this is due Professor Samuel P. Sadtler.

The course was aimed to be practical, enabling chemical students to familiarize themselves with mechanical subjects. The degree conferred was *B.S. in Ch. E.* Three years after graduation those bachelors who showed marked progress in their profession, and who submitted a satisfactory thesis, were granted the degree *Chemical Engineer.*

The program was administered by the Dept. of Chemistry and Chemical Engineering. Head of this for 30 years was Edgar Fahs Smith, who was also vice-provost and provost for 20 years, and three times President of A.C.S.

The tuition was $150 for the 33-week school year. Textbooks averaged $15 per year, and board and room costs started at $5 per week.

Chemical engineering instruction at the schools in this early period was largely descriptive industrial chemistry. Laboratory work consisted of a few mechanical operations, such as grinding, screening, and filtering, as well as simple and crude manufacture of such materials as superphosphate and alum. Electrochemical operations were provided in a course by Provost Smith. Fuel-fired and electric furnaces were used in metallurgical applications.

—M. C. Molstad

TULANE

The degree of Chemical Engineering was announced at Tulane University in 1893 and put into effect a year later. John M. Ordway was the first professor of Industrial Chemistry from 1894-97. In 1897 L. Washington Wilkinson became professor of Industrial & Sugar Chemistry, a post he held until 1913. Then, C. S. Williamson, Jr. became head of the Industrial Chemistry Dept. to provide that portion of the training for chemical engineers. It was in 1917 that the School of Chemical Engineering was separated completely from the Chemistry Dept. and placed completely under Engineering with Professor Williamson as head of the school.—*R. V. Bailey*

MICHIGAN

Sixty-two years ago, Alfred H. White, while in graduate study in chemical technology the Federal Polytechnicum in Zurich wrote to his former teacher, E. D. Campbell relating his experiences. Campbell in reply offered White a position at the University as instructor in Chemical Technology. At the end of White's first year at the University, in 1898, a curriculum for a degree in Chemical engineering was approved by the Regents, White became chairman of the Department in 1912, a post he held until 1942.

The sixty-year span since 1898 may be divided intor three periods: (1898-1923) the industrial chemical period, (1923-1943) the development of a distinctive engineering science, and (1943-1958) the era of engineering design. The background to the new program was given by the heritage of training in chemistry and association with faculty members who were conducting research. Contact of the faculty with industrial processes and problems gave impetus to the transition from industrial chemistry to the distinctive engineering science.

The graduate program which started seriously in the 1920's had a great impact on the development of chemical engineering courses. New course material was usually added at the graduate level but it soon filtered down to undergraduate courses.

By 1918, professor W. L. Badger, who served as a consultant to Swenson, had established an evaporator laboratory (see illustration) in an old powerhouse. New quarters for chemical engineering completed in 1923 included a three story pilot scale or "unit operations" laboratory. Swenson, working with Professor Badger, gave a set of evaporators and accessories to this laboratory. An important aspect of this laboratory was its use for sponsored research, a relatively rare thing in these days, giving professional experience to the faculty, and part time employment for students. About 1930, the first experimental Dowtherm boiler was built and operated in the laboratory under the direction of Badger.

During the sixty years 2546 bachelor's, 1074 master's, and 216 doctorate degrees have been granted.

—D. L. Katz

Evolution of the UNIT OPERATIONS

As brought out earlier (pp. 50-51), the publication of *A Handbook of Chemical Engineering* in both 1902 and 1905 by George E. Davis, presented the essential concept of "unit operations," and particularly furnished an understanding of its value for education.

In view of the extraordinary promise of the early work of Davis and Hausbrand, one finds it difficult to understand why development of the chemical engineering unit operations by their successors was so slow. Doubtless, it was retarded by a variety of factors.

Study of the problem makes the writer feel that probably the chief roadblock delaying progress was the unavailability, at that time, of physical chemistry as a tool in the handling of data. It is true that physical chemistry had developed in high degree in Germany during the '80's and '90's under the leadership of Ostwald and Van't Hofft; but it is also clearly true that, as a new branch of science, it had not found its way into the general curriculum of chemistry in the universities. This was in no small degree due to the lack of instructors adequately grounded in its discipline. Men like Davis and Hausbrand were unfamiliar with its methods and unaware of the extraordinary help it could afford for their problems.

ARTHUR D. LITTLE

His concepts swept through the practice and teaching areas . . . having major impact

Somewhat later (around 1907), and in connection with the chemical engineering course being operated at MIT, there came into the picture on the American side of the Atlantic the potent influence of a new forceful personality. Arthur D. Little, an alumnus of MIT in chemistry before the establishment of the course in chemical engineering, was deeply interested in professional education and, because of his broad experience as an industrial consultant and his earlier association with W. H. Walker, his interest began to focus on training in chemical engineering.

A. D. Little, then, not only saw that each of the manipulations of chemical technology was employed in a variety of chemical industries so that each could be studied independently of the specific industry in which it was to be used, as had been done by Davis and Norton, but also saw that various of these operations were closely interrelated in important ways which at that time were not recognized at all or were at least imperfectly understood. This led immediately to the development of broader and sounder analyses of operating techniques and methods of teaching.

The first record of Dr. Little's ideas, in which he coined the term "unit operations," is his report, dated, Dec. 8, 1915, as committee chairman to the President and Corporation of MIT.

"Any chemical process, on whatever scale conducted, may be resolved into a coordinated series of what may be termed "Unit-actions," as pulverizing, mixing, heating, roasting, absorbing, condensing, lixiviating, precipitating, crystallizing, filtering, dissolving, electrolyzing and so on. The number of these basic unit operations is not very large and relatively few of them are involved in any particular process. The complexity of chemical engineering results from the variety of conditions as to temperature, pressure, etc., under which the unit actions must be carried out in different processes and from the limitations as to materials of construction and design of apparatus imposed by the physical and chemical character of the reacting substances."

The concept is expanded in a 1922 report by the American Institute of Chemical Engineers' committee on education, at that time under Little's chairmanship—W. K. Lewis.

By 1940, however, the revolution had begun to run its course . . . under pressure of war, more interrelationary concepts were needed . . .

. . . Soon, more integrated steps . . . of an ever more basic and fundamental manner, began to be evolved

AT THE OUTBREAK of World War II, it was beginning to become clear that even more fundamental than the list of unit operations was a set of principles of engineering science which underlay them. Fluid mechanics, for example, was seen to be important not only in connection with the transportation of fluids (fluid flow) but also in distillation, gas absorption, filtration and fixed-bed catalytic reactors. Mass transfer was recognized as a basic mechanism in drying, extraction, adsorption, and catalytic reactors to name but a few applications.

The elucidation of such principles involves much careful research into the actual mechanisms by which processes and operations take place. This is the type of fundamental research which has traditionally been the province of the universities. World War II emptied the technical colleges of students and teachers alike. Industry had to devote its full effort to the pressing problems of production. Fundamental research, except where it was directly and urgently related to military activities, came to a virtual halt.

This is not to say that there was a moratorium on new chemical engineering techniques, operations, and processes. On the contrary, the urgency to solve problems created by the demands of production for the military gave rise to many new developments. Thus we have the appearance of fluidized bed operations, pulse columns for extraction, hypersorption, ion-exchange, and thermal diffusion separation methods etc. etc. to say nothing of the engineering of nuclear processes. The atomic age and the jet-age were ushered in, and opened up tremendous new areas for engineering of all kinds.

So great was the quantity and diversity of new industrial and scientific developments over a relatively short period of time, that a tremendous pressure was built up for fundamental engineering research and development work to be resumed as soon as possible. To meet the demands for high-temperature materials, high-energy fuels, disposal of fission products, synthetic fibers, and antibiotics, requires more accurate and detailed understanding of the structure of matter, mass, heat and momentum transfer mechanisms, thermodynamics, and other basic subjects than ever before. This understanding must rest upon firm theoretical foundations, mathematically and quantitatively expressed whenever possible. Hence research activity since the war has expanded at an enormous rate.

Comparison of the material currently being published with that of twenty or thirty years ago reveals two prominent trends: (a) operations are being analyzed both theoretically and experimentally in terms of fundamental mechanisms, instead of empirical "coefficients"; (b) these analyses are being expressed quantitatively in terms of a wide variety of advanced mathematical techniques.

The mechanisms include the boundary layer theory, momentum transfer and other principles of fluid mechanics, the modes of heat transfer, and the diffusion and eddy transport processes of mass transfer. Mathematical techniques beyond the ordinary calculus involve vector analysis, orthogonal functions, calculus of finite differences, statistical theory, numerical analysis, and many others. Some examples follow:

The theory of filtration was quite empirical until analysis in terms of fluid mechanics was applied. Much of the early experimental work seemed to point to an almost parabolic relation between quantity of filtrate and time in constant pressure filtration. But unexplained deviations from the relation were troublesome, and no basic theory existed. In 1933 Ruth showed that viscous flow occurred through filter cakes and by properly allowing for the resistance to flow offered by the filter medium as well as the cake, derived the correct form of the parabolic constant pressure filtration equation. His analysis left the properties of the cake still to be accounted for by an experimentally determined "specific resistance" term. More recently this has been further elucidated by adapting the work of Kozeny on flow through packed beds. Carman, Tiller and others have shown how the concept of hydraulic radius leads to a function giving the effect of cake porosity and particle size on the specific resistance, and the importance of the pressure stress upon the solids themselves in the variation of porosity through the cake. The goal of predicting the performance of a filtration from the fundamental properties of the fluid and solid particles composing the slurry has been brought much nearer by using analysis in terms of fundamental solid and fluid mechanics.

The earlier literature is filled with empirical correlations of heat transfer coefficients for many types of situations. Heat exchange between a solid surface and a fluid adjacent to it was a favorite subject of experimental study and many examples of it were considered. Some qualitative explanation for the dimension-less groupings used in the empirical correlations of results was provided by the surface film theory. But it remained for von Karman, Martinelli and others, building upon the earlier work of Prandtl, to analyze such situations in the light of the boundary layer theory of fluid mechanics. On this basis, for example, they have been able to postulate a mechanism and derive a theoretical relationship between the dimension-less groups for the case of turbulent flow inside a pipe, which checked experimental results. The case of heat transfer to a boiling liquid is less well understood. Empirical correlations for boiling "coefficients" have been available, but it is only with the development and application of ultra highspeed photography that a real beginning has been made into the understanding of the complex mechanism by which boiling occurs.

Mass transfer processes provide a similar example. A great variety of these exist which involve at least one fluid phase at an interface, *viz* in distillation, gas absorption, drying, humidification, extraction, and solid adsorption. It is the basic phenomenon underlying many of the most important of the traditional unit operations. The first theories of plate column distillation or absorption considered only equilibrium or ideal plate operation. The number of such theoretical plates was related to the actual number required by an empirical plate efficiency factor. The research project sponsored by the Institute since

1952 is making an effort to determine such plate efficiencies on a rational basis by studying the fundamental mechanism of mass transfer between bubbles and liquid with due consideration for the fluid mechanics involved in the flow through such towers.

The case just mentioned also affords a good example of the use of special mathematical techniques. A number of unit operations such as those in plate columns are carried out in discreet stages rather than by passing through a continuously varying set of conditions. The calculus of finite differences is the proper tool of analysis for such stage wise operations, as was first pointed out by Tiller and Tour in 1944. The differential calculus cannot be used as there are no differential variations in conditions and differential equations cannot be set up. The calculus of finite differences provides means for setting up and solving difference equations which predict the result to be obtained by employing any given number of stages or finite steps in the operation.

The analysis of the many differential processes remains very important of course, and we find many examples of the increasing use of the techniques of solving ordinary and partial differential equations. An illustration of the growth in interest of the chemical engineer in the use of this kind of mathematics is illustrated by the case of heat transfer from fluids to solids in fixed beds of granular particles. In 1930 Furnas published a study based upon excellent mathematics but emphasizing empirical correlations of coefficients. In 1950 Singer and Wilhelm, considering the same subject, plunged in by writing a series of partial differential equations in vector notation and developed solutions in terms of Bessel functions that displayed considerable mathematical sophistication. This article also showed that in twenty years it had become possible to make a detailed study of the mechanisms by which heat is transferred in a packed bed.

Greater familiarity with setting up and solving partial differential equations has also permitted us to tackle unsteady state problems. We no longer hesitate to consider theoretically the transient conditions associated with start-up and shut-down of operations or of fluctuations in process variables. In fact the experimental study of the behavior of a system in responding to an upset in conditions deliberately and systematically introduced ("frequency response") has become an important research tool. An understanding of transient phenomena is also the basis for automatic control theory.

The statistical approach or use of mathematical probability theory is also becoming important. An early example was the study of liquid distribution in packed towers by Lerman and Tour. Mass transfer processes in fixed beds have been studied by the "random-walk" theory by Baron, and of course there is the whole field of analysis of data, design of experiments, and quality control which has developed since the war.

An interesting example of the use of vector analysis is that of Garber and Goodman in studying fractional crystallization. The complex solid-liquid phase equilibria in multi-component salt solutions are represented by space geometry. The path of a crystallization process is followed by tracing vectors in this space in order to determine the nature and quantity of the solid phases which will appear.

THUS we are clearly becoming more painstaking in finding out the underlying mechanisms which govern the operations, and more sophisticated in using the appropriate mathematical tools of analysis.

Our ability to make such investigations is of course greatly dependent upon new experimental research techniques which have become available.

Our ability to use advanced mathematical tools is also dependent in turn upon the availability of high-speed machine computations.

Our greater knowledge has taught us that we may systematically group and classify the principles of the unit operations according to underlying scientific phenomena. In this way the treatment of the unit operations is further unified. Instead of a list of individual operations treated separately, almost as though they shared nothing in common, we have groups of basic concepts which apply to many operations which are thus interrelated.

Finally something should be said about the present status of distinction between physical operations and chemical processes and about what has happened to the "unit process" concept. As the analysis of mechanisms has become more detailed, it has become clearer that there is a great deal of interrelationship between the physical and chemical aspects. In a solid catalytic reactor, for example, the physical steps of mass transfer, diffusion, and adsorption may be even more important in determining the overall rate of formation of products than the chemical reaction on the surface of the catalyst. In the design of such a reactor the physical aspects of heat transfer and fluid flow (pressure drop) must also be given important consideration. We can hardly classify the operation as either physical or chemical; it is a complex interaction of both types of phenomena.

The whole realm of phase equilibria, basic to many types of separation operations, is usually thought of as a physical problem. But when it is considered in terms of molecular structure and bonding forces between molecules it becomes a problem of chemistry.

The term unit operations is certainly not going to disappear although it may become more loosely used. It has too long and important a history associated with the growth of Chemical Engineering as a distinct profession. The concept of a manufacturing process consisting of a coordinated series of unit physical operations and unit chemical processes remains valid. Chemical engineers will always use this as a guide in their approach to process design, development, and operation. But they will look at these integral steps in the series in an ever more basic and fundamental manner as knowledge of the structure, properties and behavior of matter continues to increase. —W. Licht, Jr.

Both W. K. Lewis' & W. Licht, Jr.'s contributions were excerpted from papers to be presented at A.I.Ch.E. Jubilee.

Forever

The chemical industry's unending battle against obsolescence of its processing facilities is well demonstrated by this frank study of America's classic high pressure ammonia synthesis plant

The history of the Du Pont Company's Belle Works—the country's first high pressure (15,000 lb./sq. in.) ammonia synthesis plant—is one of almost constant change, much of it to combat obsolesence. Belle Works began operations in 1926 on a 105-acre plot some ten miles southeast of Charleston, West Virginia. On the plant site along the banks of the Kanawha River were located a powerhouse with two gas-fired boilers, a gas generator house with four hand clinkered gas sets for making water gas, a factory building containing three Claude gas compressors, three liquefaction units with scrubbing facilities, one unit for burning hydrogen with air to obtain nitrogen, four 7½ ton hyper compressors, and four Claude ammonia synthesis units, one ammonia storage building with six spheres, two large gas holders, and one pumphouse for raw river water. These facilities produced Belle's first ammonia on April 1, 1926. Customers, a great many of them in the explosives business, were calling for about 200 tons of Belle Works ammonia daily.

Availability of abundant coal resources in West Virginia fields provoked continuing technical inquiry and by the early 30's this resulted in the installation of a commercial urea

Obsolescence

manufacturing process at Belle. Methanol manufacture from a part of the synthesis gas stream also originated at this time. The plant's ammonia production increased by fifty per cent to accommodate the demands of products derived from it.

The Belle Works landscape continued to change. Laboratory scale manufacture had been achieved on a linear super polymer at the company's Wilmington, Delaware research center. They called it "nylon" and asked Belle Works to establish pilot plants for adipic acid and hexamethylene diamine. In 1939, nylon salt came into commercial scale at Belle Works. Ammonia production went to 400 tons a day, partially as a result of demands originating with nylon synthesis.

Meanwhile, coal (and its conversion to coke) was beginning to represent a greater and greater share of the total production bill. Company engineers became convinced that these so-called "incidentals" of coal-based operation represented an ever-increasing problem of maintenance and disposal of ash and other wastes.

Accordingly, studies were made to determine the utility of converting the plant to the use of oxygen as a substitute for air in the coke-fueled gas synthesis sets, and also to the use of natural gas, should it become ultimately available. These studies, however, were interrupted by World War II, which brought a new and immediate demand for further increase in ammonia production.

The Nation's wartime ammonia demand caused competing plants to spring up throughout the country, particularly in natural gas producing areas. Its modernization program now well off schedule, Belle Works was faced with the fact that much of the plant was obsolete.

There were three critical disadvantages faced by Belle Works: (1) an expensive, out-moded coal-to-coke-based process, (2) a less-than-ideal location for satisfying the growing market in fertilizers, and (3) an impending major overhaul or rebuilding for the plant's coke ovens, which had been inspected and found close to the end of their useful life. Experience at one of its Texas installations, furthermore, had shown that natural gas-based plants could ultimately offer ammonia at costs to the customer which were to challenge the profitable operation of Belle Works as an ammonia producer.

During 1944-46, Belle works remained a subject of serious discussion within the Du Pont Company. The question of abandonment of ammonia synthesis was debated and considered seriously; much of the plant investment had by this time been amortized. By adopting a policy of sharply restricted maintenance and similar programs, the plant probably could be operated for a time at a profit.

But Du Pont has never operated under such a policy, and as a consequence the sweeping decision was made to conduct further broad investigative work aimed at keeping Belle Works in a competitive position. These investigations proceeded in several directions, but in 1946 and 1947 the most promising areas for exploration involved some engineering data on burning coal directly by partial combustion with oxygen for preparation of synthesis gas, by-passing the coke stage. As an intermediate step in modernization, cost analysis showed that the use of oxygen in the existing coke-fueled gas generators would be economically attractive.

Development work began in 1947 on a method of coal partial combustion. Meanwhile, a plant was constructed for production of oxygen and some existing sets were converted for its use. After three years in laboratory development and pilot plant experience, design of the coal partial combustion unit was undertaken and completed in 1952. Construction forces went to work and by 1955 the unit went on stream.

Integrated with Belle Works production, coal partial combustion made a favorable change in the plant's economic complexion. However, recomputed cost analysis showed clearly that a switchover to natural gas would still be desirable.

The intervening expansion period had attracted more and more chemical manufacturing companies to the ammonia business. A still uneconomic process system and a product that was, in the final analysis, uncompetitive, brought Belle Works to a bleak question for the second time since the end of World War II: "Should the ammonia synthesis be abandoned?"

Only two years earlier, in 1954, it was learned that natural gas was to become available at Belle. The building of a pipeline from Texas gas fields had been under way for some time and this line would pass close enough to Belle to be considered for a tie-in. But pipeline proximity did not in itself offer sufficient attractions; primarily because an adequate supply of Texas gas could not be guaranteed to industry. A fairly unexpected and more compelling factor, the development of vast natural gas storage facilities in West Virginia, re-opened the gas question and offered industry its guaranteed supply. The decision was announced in Spring, 1956 to convert to natural gas.

The gas supplying utility proceeded with construction of its pipeline 17 miles across razorback ridges from its main at Coco Station, making possible delivery in December, 1956.

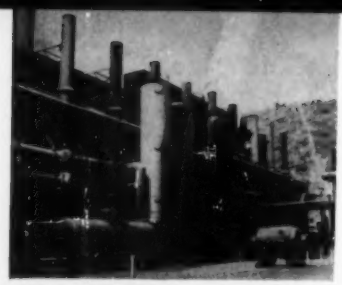
Once the decision was made, conversion was undertaken with experience. Current production capacities had to be sustained and even boosted during the conversion period.

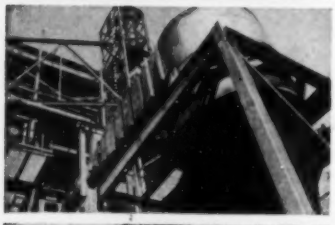
Number one gas holder, a plant landmark for more than three decades, was to be torn down—it was no longer needed for surge storage because the natural gas was "riding on the line." Removal of the holder opened space for construction and design people to move into and begin the installation of new equipment needed for handling gas at high pressures.

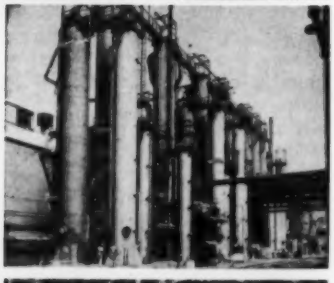
By early Spring of this year (1958) a balance sheet of sorts was drawn.

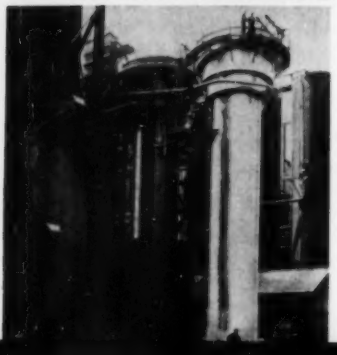
Area residents and plant personnel at all levels were beginning to understand the curious mathematics of Belle's modernization. Substraction was adding up. Modernization they now saw not as a complex of new

continued on page 70









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equipment and buildings added to an existing plant, but as a careful subtraction of elements which could be removed and at the same time enhance the plant as a neighbor and as a place to work. Two new major structures were being built. They would occupy less than two acres. They were to 'replace equipment which called for nearly 12 acres of space.

Coming out of the Belle skyline were gas scrubbers, the coke plant, the liquefaction unit, the gas house, the coal partial combustion unit, the caustic plant and almost half the low pressures compressors.

In their place were being built four natural gas partial combustion units as the first stage in Belle's modernized process train and a modern control room which is expected to provide better control, higher quality in product, more efficient use of labor and better balance between products.

The economic advantages are clear. Belle Works will be competing on at least equal footing with other ammonia producers. The urea marketplace, now crowded with manufacturers operating integrated plants, will find Belle as fit for the contest as any. Since ammonia represents a considerable share of the urea manufacturing cost, a new ammonia system for Belle (higher pressure partial combustion) will enable the plant to enter wider selling areas in the plastics and fertilizer field.

While this renovation and further improvement is going on, a marginal, but no means insignificant benefit is accruing to the plant by virtue of immensely reduced atmospheric and stream pollution control costs.

In the meantime, current business conditions are being faced with greater equanimity at this plant. Belle Works is prepared to have what its management feels is a reasonable share of the market. In the face of the inevitable business cycles, Belle's austerity programs, on one hand, need be no more severe than those of its competitors, whereas if inflationary trends continue, Belle's manufacturing costs should rise no more rapidly than those of its competitors.

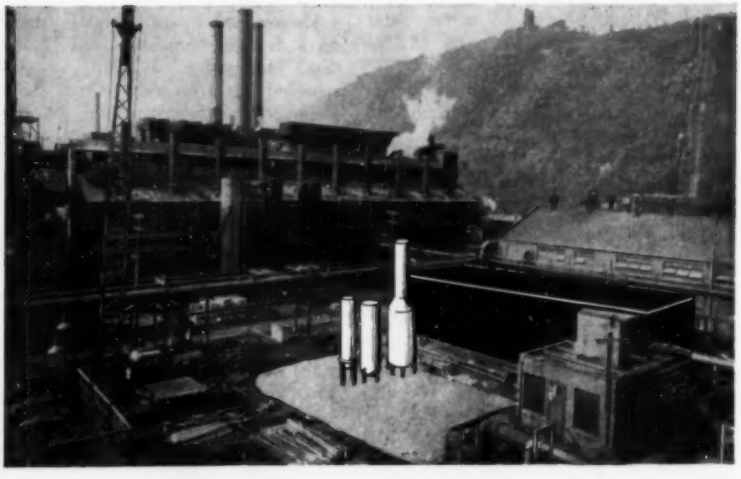
What's more, Belle Works has an ace in the hole—coal. This plant's operating experience has shown the company that Du Pont coal technology can be resorted to even now if circumstances should require it.

So ends . . . for the time being . . . the story of a plant's fight against obsolesence. What will the next decade be like? There's hardly an engineer familiar with the history, that will hazard a guess.

Subtraction = Modernization

These come out

These go in

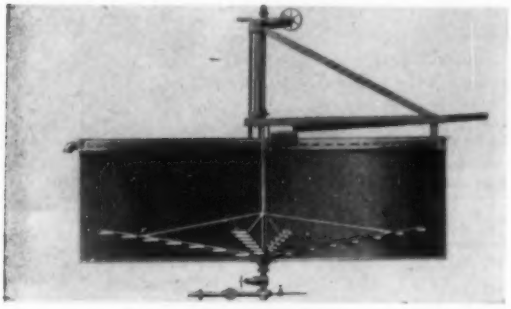


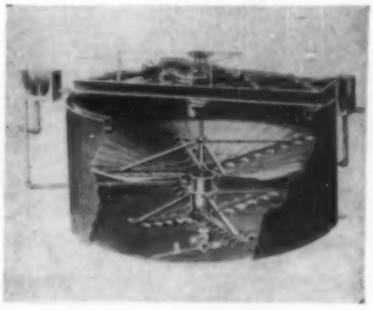
Lummus' first floor-fired oil heater ever built for refining service —1934.

Typical modern Lummus heater, in fixed-bed catalytic reforming service—1956.

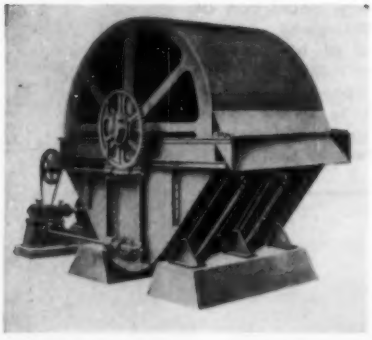
The development of PROCESSING EQUIPMENT

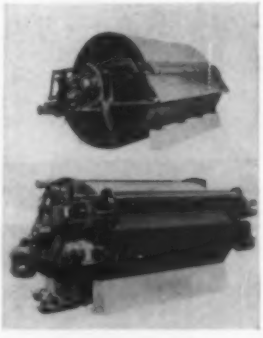
Chemical engineers play vital roles in the development of processing equipment, both as process engineers in operating and engineer-constructor organizations, as well as technical sales engineers for equipment manufacturers and fabricators. Out of this collaboration has come equipment for increasingly complex chemical systems, often subject to comparatively extreme conditions of corrosion, erosion, temperature, and vacuum and/or pressure. Briefly illustrated are some examples of progress through design simplification, use of newer materials, and increased accessibility and ruggedness—to attain greater capacity, reduced maintenance, and longer service life within economic realism. Streamlining, as will be seen, has not been neglected. *E. J. Lyons & T. T. Meehan*, for Chemical Equipment Sales Engineers Association (New York).



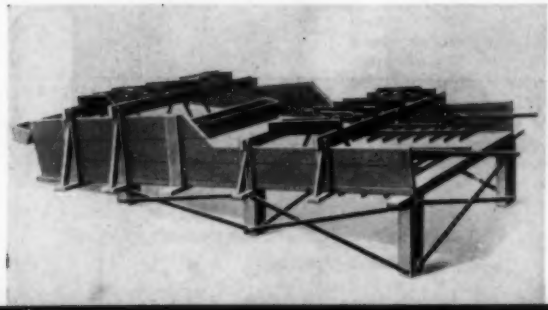


Left—J. V. N. Dorr's first thickener, invented 1906, and installed at Mogul-Mining Co., Pluma, So. Dakota. **Right**—latest model Dorr Tray Thickener, showing stacked tray design which saves floor space, reduces heating area and cost of tanks.





Left—1908 model rotary filter with open head, air lift and paddle agitation. **Right, above** later (1922) closed head, overhead suspension swing agitator, chain driven, with larger, two-solution valve. **Lower**—Modern closed head, high submergence, paddle agitator, direct coupled enclosed drives with micrometer advanced scraper and individual conveyor drive. Modified for continuous perssure filtration.



Left—The original Model "A" Dorr Classifier built for ore dressing service just after 1900. **Right**—New unit shown in quadruple design, derived from original 1930 model. 16-ft. machine as shown is capable of classifying 1500 tons/day at 48 mesh with circulating load of 7 to 1.
—Courtesy Dorr-Oliver

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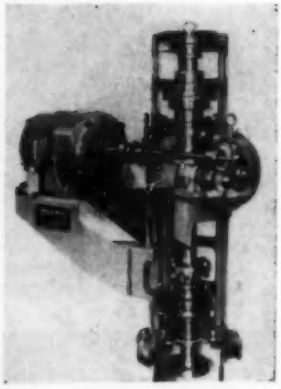
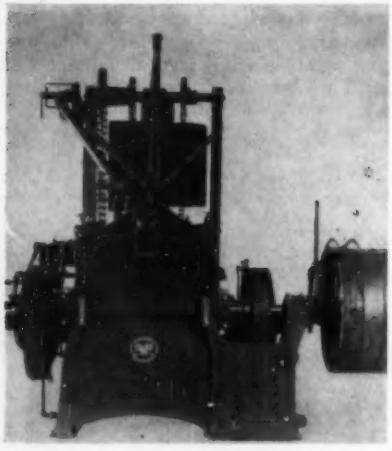
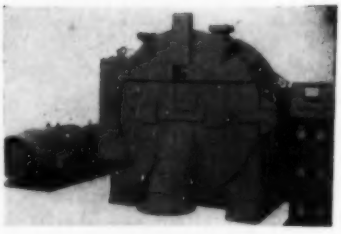
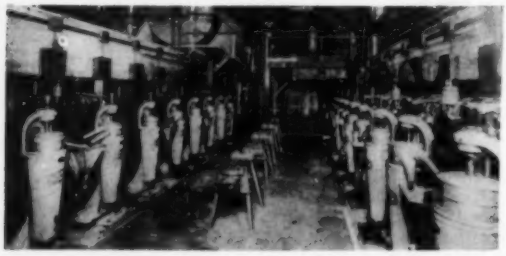


Left—A classic in early mixers—Mixing Equipment Company's "Model 1" of circa 1918. **Right**—The latest in Mixco's gear suspensions, which interestingly enough bears Model No. "218-TECDS-32." Features interchangeable gears for different ratios, shaft-whip effect isolation from gears, etc.—**Courtesy Mixing Equipment Co.**





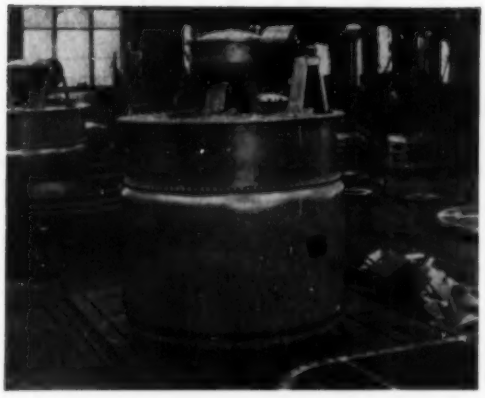
Left—Baker-Perkins' vacuum mixer circa 1925. **Above**—Vacuum mixer modernized to allow full (2 to 3 mm.) vacuum without manual disconnection or clamping between batches. **Right**—B-P Ter Meer Automatic Centrifugal of modern design that eliminates earlier outboard bearings, provides accurate timing, with complete access.—**Courtesy Baker-Perkins.**



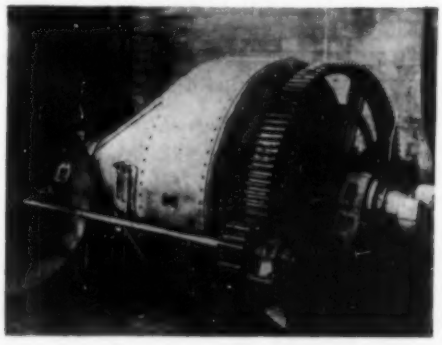
Left—An early installation of centrifuges processing cottonseed oil. One of the modern machines shown on **right**, with its "stacked" cones, can handle as much capacity as the entire group shown in the old picture. —**Courtesy Sharples Corp.**

Left—Typical jacketed reaction vessel equipped with top-entering mixer built about 1927. Note belt drive. **Right**—modern reaction vessel, which happens to be a contactor for butane isomerization. Note "streamlining", with improved access.—**Courtesy Turbo-Mixer Div. GATX.**

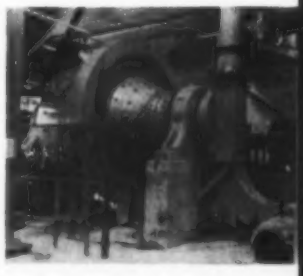
Development of PROCESSING EQUIPMENT



Left—Another variety of jacketed mixing tank, circa 1929. Note belt drive, combination welded-riveted construction of vessel. **Right**—a modern "streamlined" version of obvious complexity, yet with open accessibility. Supporting structures impart a sense of massive rigidity, but with balance. —**Courtesy Struthers-Wells.**



Left—An eight-foot pebble mill being installed at Braden Copper Company, Chile, circa 1912. Open gearing, belt drive, and riveted construction was common of the period. **Right** — Modern eight-foot pneumatic-classifying "Thermo-Mill" at a Canadian titanium pigment plant. Exposed studs indicate modern method of securing inner wear plate liners. —**Courtesy Hardinge.**



Two excellent examples of the early process equipment makers' art are shown in these photographs. On the **left,** a massively designed cast iron steam jacketed mixing kettle is shown on the shop floor, before shipment, on October 14, 1919. On the **right** is a horizontal tube evaporator of riveted construction. Here, accessibility of the tubes was assured through a complex pipefitting arrangement. Nameplate appears to indicate the year 1925.—**Courtesy Buflovak.**

Left — Two early triple-effect horizontal tube-type evaporators for black liquor concentration. **Right** —One of first long tube vertical evaporators in southern pulp mill. Triple-effect, of welded steel. **Courtesy Swenson Div., Whiting Corp.**

and now, about the FUTURE *of your*

In rounding out its 50th year, the Institute is busily looking ahead to an even more active, more broadly participative, future. Here is a summary of opinion and plans to give you a quick resume of . . .

. . . what to expect in the future.

"We must produce a great age, or see the collapse of the upward strivings of our race."

A. N. Whitehead

It is impossible to contemplate a future for any of the institutions of men without recognizing that, like everything else, it is a corollary of mankind's future. Should the wisdom of men make the world peaceful, engineering will be prosperous; should the folly of men triumph, engineering will construct the guillotines. We are men and brothers first, engineers secondarily; we are our brother's keeper, and he is ours. These are to me the facts of the future for the A.I.Ch.E., and since I am an unabashed optimist, the future seems fair.

One can't with good conscience speak of the future of A.I.Ch.E., for I personally doubt that we will celebrate our hundredth anniversary as a sovereign organization. Engineering will still be our calling, but as part of one cohesive group, cemented by underlying common laws of engineering fathered in the minds of engineers, and calculated by electronic slaves. The technologic and educational tools of 2008 are already plain. A basic engineering education will produce men trained to apply fundamental operations in any industry, just as chemical engineers have applied unit operations to any chemical operation, in any process. Automation will direct, produce, calculate, correspond, translate, record and store. Unlimited sources of energy will synthesize materials. With the three engineering necessities – labor liberated by automation, fabulously trained men, plus energy in unlimited quantities, engineers and engineering miracles will transform life. How then will chemical engineers preserve their identity? Possibly as a division of an overall engineering association. But have no fears, our progeny will still be chemical engineers, well aware of the slow and painful steps we took to accumulate the knowledge with which to fashion wisdom, for it will be to them also a slow and painful process, with a promised world of glories still ahead of them, just as it is for us.

F. J. Van Antwerpen
Secretary, A.I.Ch.E.

What's ahead— with the Institute's committees

The real source of creativity in advancing a profession lies within a society's volunteer-manned committees. Here, in highly digested form, are the results of a survey of the outlook for various of the Institute's key committees, as reported by their chairmen.

Career guidance

Informing and interesting high school and pre-high school youth of this country in chemical engineering as a profession, and instilling professional precepts in students' minds at the time they are selecting a career, are among the vital functions of the Career Guidance committee performed at Local Section level.

Looking to the future, the committee is now setting up groups to study the professions' needs for chemical engineers in the near future. It is interested in studying the problem of quality as well as quantity. To this end, statistical investigations are being made of the large variety of enrollments of students in scientific and engineering courses, taking special note of the proportion interested in chemical engineering, and related fields.

Education projects

It is now generally conceded that *engineering sciences* will be the basis of the necessary power of the next generation of students to solve chemical engineering problems. Whatever the trend of the times, the Projects committee will continue to serve the teaching profession in whatever way it can by promoting the teaching process. The publication of such items as *Chemical Engineering Faculties, Library Booklists, Educational Films and Filmstrips,* and *Chemical Engineering Problems* will continue so long as the need for them exists. Constant improvement in each of these reflects the industry of the men who create them. As the nature of chemical engineering education changes for the better, the scope and content of the publications will be increased. The industry-sponsored teach-the-teacher schools are being held in new areas, and are being enthusiastically received.

The committee feels that it can perform a useful service, particularly in the coming decade, in helping colleges locate bright young men to add to their teaching staffs; and helping young men in industry find a suitable place in college teaching. A start has been made, and the service should grow rapidly.

Equipment testing procedures

The ultimate goal of the equipment testing committee is to produce a set of testing procedures sufficiently complete so that practically any piece of equipment in a chemical process unit can be tested in accordance with a Standard. It is believed that this will be of the most value to practicing engineers who are concerned with the performance of equipment.

Three Procedures have already been issued by the committee; Sensible Heat Exchangers (tubular), Condensers (tubular), and Absorbers. It is expected that Procedures will be issued in the very near future covering Distillation Equipment, Vaporizors, Mixers, and Pumps. Also in preparation are Procedures dealing with Dryers, Evaporators, Measurement Meth-

INSTITUTE

ods, and Corrosion Testing. It may turn out that more than one procedure may be required under any one of these headings, as was the case with Heat Exchangers.

Standards

Among projects being developed currently are: Standards for Shell & Tube Heat Exchangers for Chemical Process Use; Standard Specifications for Rectifying Columns & Towers; and Standards for Mixers. A look into the future indicates that we will be considering the development of Standards for the basic equipment units used in chemical operations, such as Standards for Absorbers, Dryers, Evaporators, and Distillation equipment. Of importance will be the development of chemical engineering standards in the nuclear field, under ASA auspices.

Student chapters

We see greater opportunities of promoting the professional attitude among young people entering chemical engineering. With time, these people, in increasing numbers, will form the main source of new members in the Institute. It is our responsibility to make certain that they will be an asset to the Institute.

Awards

For many years the Institute has given the Junior Award, the Walker Award and the Professional Progress Award. For the 50th Anniversary, Council has initiated the Founders Awards, which, although created as part of the Anniversary program, are planned to be continued in the future.

Pollution control engineering

This committee will assist in meeting the challenge by assuming responsibility for the soundness of the chemical engineering aspects of various air and water pollution abatement programs. It has, and will continue to cooperate with other similar organizations to advance waste control and prevent duplication of effort.

Admissions

Using its best judgment in evaluating candidates under the standards set forth in the Constitution, this committee will continue to review all applicants for membership, and recommend to Council the names of qualified applicants in the appropriate grade. At present no necessity is seen for any change in Constitutional provisions regarding membership.

Professional development

The Committee's programs will be to encourage professional achievement in the individual and to encourage the recognition by management and the public, of the inherent professional character of engineering work. It plans to investigate the licensing of engineers and its relation to professional development; and in the future, it will make full use of ECPD efforts.

Professional legislation

The Legislation committee is currently working with EJC-ECPD towards developing for consideration a statement of policy covering registration (licensing) of chemical engineers. Such policy would guide States in regulating the practice of engineering by individuals employed by corporations. The committee agrees that State control should be permitted if adequate safeguards are provided to protect the public against malpractice. The differences of opinion lie in the area defining the number and type of such safeguards.

Engineering laws have not affected the individual chemical engineer to any extent in the past, but it is ventured that such laws will gradually become more restrictive.

Public relations

Starting this year, periodic bulletins are being distributed to local section Public Relations committee members to inform other sections of successful programs and to encourage a better exchange of ideas.

The program of the Public Relations committee will be to see that the many opportunities for local sections and individual members to become respected forces in their communities are not lost.

Program

Meeting programs are being planned to reflect the revolutionary technologic advances taking place so that the individual engineer can have access to information well beyond his normal reach. The meetings will be such as to encourage the bringing together of men of like interests, providing the means for profitable exchange of ideas, giving the young engineer the opportunity to mix with the experienced and grow professionally.

Publications

As the organization representative of chemical engineering in this country, the A.I.Ch.E. is responsible for providing adequate publications in its field.

Contributions for CEP should present subject matter of current professional interest and utility. The wide and varied readers' interests should be given priority in allocating limited publication space. CEP is intended to be the medium through which chemical engineers and others who are concerned with the diversified aspects of the profession can formally communicate with each other on current matters.

Contributions selected for the A.I.Ch.E. Journal should present subject matter of long-term professional interest and utility. The Journal is intended to be a medium for transmitting progress in the basic, technical aspects of chemical engineering and supporting sciences; at the same time it becomes a repository for contributions of permanent value.

Education and accreditation

The efforts of this committee will necessarily be directed more strongly to upgrading the education of chemical engineers. We appear to be at the cross-roads in chemical engineering education, and the future is not clear. All engineering is becoming more scientific, and there is a greater acceptance of the value of the general education in the humanities and social sciences. It will often be difficult to determine the scope of a curriculum, due to greater freedom of electives tailored to meet the needs of an individual. Probably the growth of graduate study, research, and specialized graduate work for industrial groups will begin to be of more concern to the committee.

***and finally* . . . A message from the President** ➡

A message from the president

on the future of your institute

IT IS TIMELY that we should take a look into the future to attempt to see clearly the opportunities for better service to members, as well as opportunities which involve the relationship between chemical engineers and those engaged in other segments of the engineering profession and related disciplines. We should determine the most constructive and appropriate position of the Institute relative to international relations. We should also look simultaneously at the problems which the future may hold.

In this connection it is entirely possible that the greatest opportunities and the most difficult problems ahead may reside within the internal operation of the Institute, the first area to be considered in this writing. The problem is primarily one of conducting more efficiently, more effectively, and on a more timely basis the programs in which we are now engaged. Solutions lie in enlightened reorganization, improved communication, and the delegation of responsibility followed up by rigorous auditing of performance. The situation is complicated by the need for coordinating the efforts of a full-time staff in New York with the many institute members working on a voluntary part-time basis in committees, sections, and divisions. Certainly, all professional societies have this problem and no ideal solution has evolved.

The Institute is now a sizable, mature organization and, as it continues to grow, the leaders in its Committees, Sections, Divisions, and national organization will have to carry greater responsibilities than has been the case in the past. These leaders at all levels should demonstrate competency before undertaking assignments that involve new or greater responsibility. They must be so dedicated to the best interests of the society and the profession that the gap left by the absence of profit motives and competitive incentives can be bridged most effectively.

With respect to divisions of interest, this is a technique of organization which we must promptly learn to use wisely. Enlightened use of this technique however can contribute to greater service to the profession and strength in the institute. Through divisions we should encourage concentration in logical fields of specialization in an atmosphere which reflects dedication to breadth of interest and over-all unity of purpose.

Another perennial problem of the institute which must be approached in a forthright manner is the one of finances. This has to do with our inadequate financial reserve as related to our annual income and expenditures. The impact of retrenchment necessitated by financial stress or adversity becomes greater as the organization grows. The Institute must build up a reserve which will be adequate to continue all justifiable functions at an acceptable level even during periods of three to four years of sharply reduced income. To do this, we must therefore resolve not only to live within our current means but also to set aside an annual contribution to this reserve. The possibility of augmenting this by special gifts and bequests should be explored and developed at an early date.

The activities of local sections can and should be enhanced by further coordination and improved communications. This has been a recognized problem and some improvements have been accomplished, but we have yet to find the most effective and efficient means.

Student chapters, which benefit so much from the dedicated faculty counselors, can be further encouraged and aided by better over-all organization and planning. We must and will find ways to assist the counselors in bringing to their students the inspiration and experience of our mature members.

A SECOND AREA involves the Institute and its relations with other societies. It seems inevitable that some unification and simplification in engineering-society structure must be accomplished if the best interests of all are to be served. Cooperation between engineering societies will be even more important in the future and improved ways of making more effective their combined effort must be found.

The A.I.Ch.E. is in the process of joining with the four founder societies in the United Engineering Trustees. The conception of the new engineering building certainly accelerated this natural development. Greater emphasis on efforts to consolidate, coordinate, and simplify intersociety relationships constitutes a most worthwhile endeavor in the spirit of service to the profession of engineering and in the best interests of the public at large.

THERE IS A THIRD and final major area that holds even longer term opportunities and problems. This has to do with world-wide implications of the engineering profession which like many other professions, and like basic science itself, is not circumscribed by race, color, creed, or nationality. In that respect engineering should be globally homogeneous and geographically indivisible. Historically, however, the professions have sprung up and blossomed as a whole series of national oases. Communication and exchange of ideas should be fostered between these groups by international meetings, translation and wide distribution of literature, and removal of restrictions that prevent free travel of individuals. Surely the future holds more promise than one can glean from an extrapolation of the past. Here again, time, patience, and perseverance will guarantee ultimately a world-wide effort of professional people dedicated to the benefaction of man wherever and whoever he may be. Patiently, and with due consideration to the political realities of life, we must move forward toward the use of the universal language of our professions as a medium for the attainment of higher standards of living and morality in an era of lasting peace. —GEORGE E. HOLBROOK

LOOKING TO THE FUTURE

1 . . . . . Domestic developments likely to affect your future

The privately operated development groups—industrial, consulting, academic—have long constituted chemical engineering's front line forces pioneering for better tools, better processes, and above all, better understanding of nature's secrets. As a fitting continuation of the *story of a Jubilee, CEP* presents the following samples of what chemical engineers are doing in the early stages of creating tomorrow's techniques.

The head of Vitro's Arc Development department explains data to a Vitro Engineering executive, as an operator adjusts the two-inch diameter high-intensity arc in the manganese pilot plant.

Roundup of developments for the future in chemical engineering

High Intensity Arc Process Solubilizes Domestic Manganese Silicate Ores

A pilot plant for high intensity arc treatment of domestic manganese ores is in operation at the West Orange Laboratory of Vitro under General Services Administration contract. Two-inch diameter ore-bearing electrodes are used, which probably represents the largest electrodes ever employed in a high intesnity arc. The ore being treated is rhodonite, a manganese silicate, abundant in the San Juan mountains of Colorado.

While full evaluation of the pilot plant operation is not yet available, Vitro reports that, using electrodes of 85% rhodonite, unit power consumption values of lower than 3 KWH/lb of ore processed are obtained. Under these conditions, the percentage of insoluble Mn in the ore (as manganese silicate) converted to soluble Mn in the arc product (as manganous oxide) has been better than 90%. Data from this operation will permit scaling up to anodes of larger diameters with increased process efficiences.

This technique, known as the Sheer-Korman Process after its inventors Charles Sheer, Head of Vitro's Arc Research Department, and Samuel Korman, is marked by its simplicity. The raw materials consist of the rhodonite ore and a relatively small amount of carbon source material. As these are mixed, water and an extrusion aid material are added. The mixture is then placed in a hydraulic extrusion press and extruded in the desired diameter and length. The resulting green electrodes are baked rapidly at relatively low temperatures; the baking cycle reaching a maximum of 1000°C or less and extending over only a few hours, the specific time and temperature depending on the characteristics required.

Performance of these ore-bearing electrodes in the arc has been shown to be free of many of the usual process problems encountered in ore treatment at high temperatures. Although temperatures in the arc are between 7,000 and 10,000°C, operation can be interrupted and re-initiated at will since there is little mass to be heated and no melt to freeze. As presently installed, the hot fume from the arc is cooled to suitable temperatures for felt bag collection by the introduction of tempering air into the stream. The resulting arc product consists primarily of MnO and SiO_2, the percentage of manganese depending on the grade of the feed material. As MnO, the manganese can be readily separated from the silica by means of wet selective leaching techniques.

Interest in this process as an economical means of utilizing the large quantities of siliceous manganese ore available in this country is high. Its development is continuing toward operation at larger scale. #

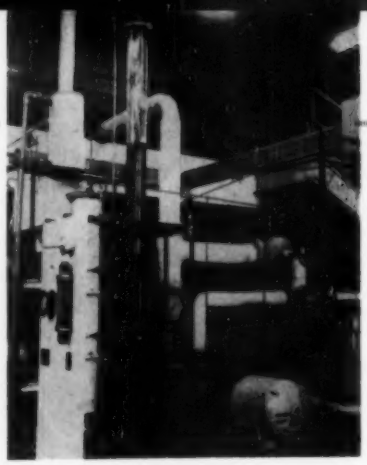
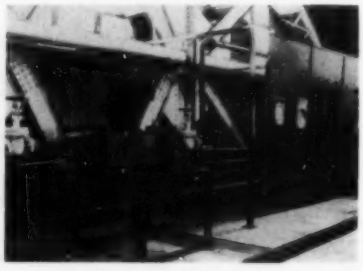


Figure 1. shows the main pumping section which has two high pressure, high volume pumps manifolded for either series, parallel, or individual flow; the water demineralization and deoxygenation (dissolved oxygen) system for maintaining high purity water; and the recirculating fluid storage tank.

Figure 2. shows the general area of test section installation which is operated on a by-pass off the main circulating loop. The test section shown in the Figure is a dummy installed solely for "mock-up" and allignment purposes. The main instrument control panel is shown at the extreme right of the photograph.

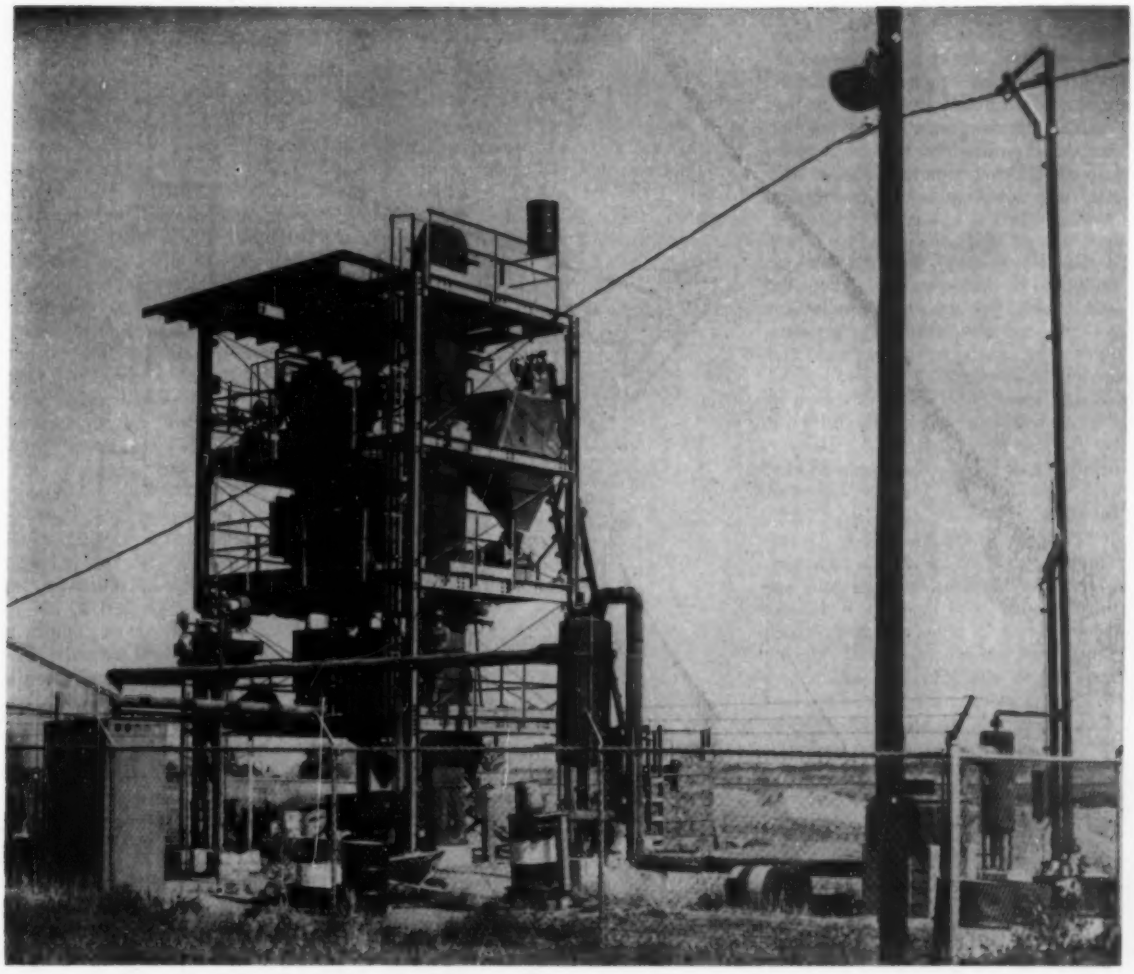


Extrusion of ore-bearing anodes at pressures approximating 4,000 lb./sq. in.

Inside the chamber: 2-in. ore bearing anode under a 1-in. cathode.

High velocity hydraulic loop for studying heat, mass, and momentum transfer at elevated temperatures and pressures

The Chemical Engineering Dept. at Carnegie Tech. has installed a high velocity hydraulic loop for carrying out heat, mass, and momentum transfer research at Reynolds Numbers that have been heretofore unattainable and/or unreported in the literature. As presently operating, the loop is capable of circulating high purity water at flow rates in the range of 500 to 700 gallons per minute at temperatures up to 300°F and pressures (or pressure drops) up to 500 psig. The project is under the supervision of R. B. Beckmann and R. R. Rothfus.



Aspeco oil shale pilot plant, showing service facilities.

Aspeco Pilot Plant Demonstrates Advantages For Oil Shale Retorting

A new oil shale retorting process has been under pilot plant evaluation for some time near the shale beds of the Colorado Plateau. Here is the latest available information on results being obtained.

Heart of the process is a horizontal rotating kiln, in which hot-metal or refractory-ball heat carriers, are caused to flow countercurrently to crushed oil shale. As a result of the solid-to-solid contact so obtained, the shale is heated to pyrolyzing temperature in the absence of air, thus releasing vapors of shale oil which are withdrawn and condensed. There are discharged from opposite ends of the rotating kiln shale coke containing residual carbon (at 850-900°F.) and cooled balls (at approximately 250°F.), respectively.

In order to reheat the balls, it was proposed in the original patents that the shale coke and cooled balls be fed to a second rotating kiln also operating in countercurrent flow. Air was to be introduced into this "combustion kiln" through the peripheral louvers, and the carbon burned off the shale coke. The balls thus reheated were then, of course, to be returned to the retorting kiln, and the shale ash discharged to waste.

The major advantage of the process lies in the inherently higher throughput rates possible in a rotary retort (in comparison to a vertical retort),

continued on page 80

Based on a paper "Progress report of Aspeco Process of oil shale retorting," recently presented before the National Western Mining Conference, Denver.

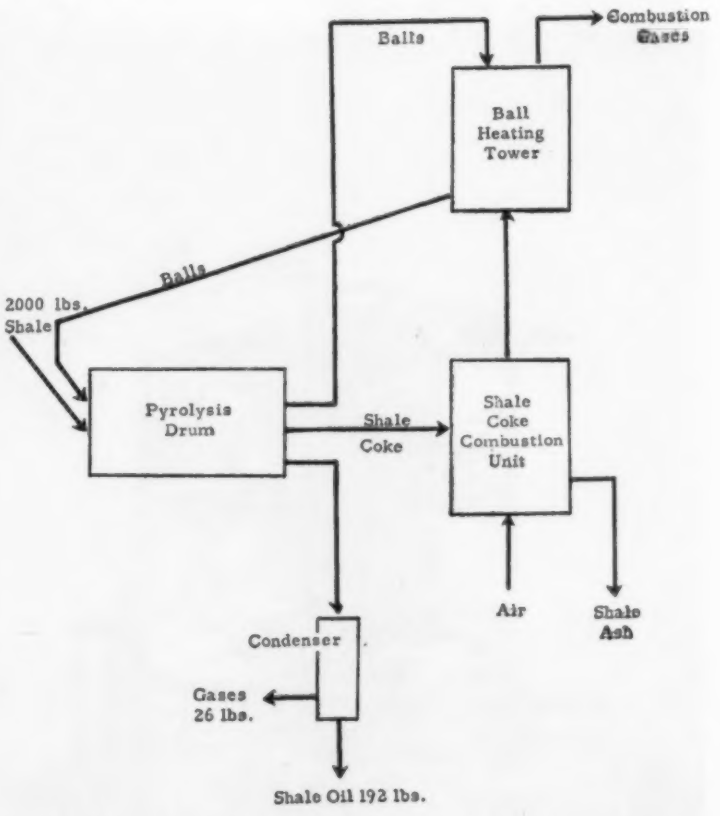
provided, of course, that the full potential of solid-to-solid heat transfer by conduction could be realized. Balanced against this fact was a possible increased cost due to necessity for crushing the raw shale feed to smaller size than required by the usual vertical retort. Other factors, both pro and con, are noted later in this report.

THE 25-ton/day pilot consists essentially of the pyrolysis kiln, the ball heating furnace, the oil collection system, and the necessary auxiliary equipment such as shale and ball feeders, blowers, and condensers. An over-all view of the plant is shown in Figure I. It was designed and built by Stearns-Roger Mfg. Co., Denver, on the basis of information developed and furnished by Denver Research Institute.

The pyrolysis kiln is 2 ft. in diameter by 5 ft. in length. Alumina balls of 1-in. diam. are fed into one end of the kiln through a bonnet which serves as a gas seal from which the oil vapors are recovered. During rotation of the kiln the balls move to the opposite end of the kiln where they are picked up and discharged by the ball pickup device. The raw shale enters the ball discharge end of the kiln and moves counter-current to the balls. It is discharged through a trommel section with ¾-in. openings which prevent the balls from being discharged with the retorted shale.

The balls are fed to the kiln at temperatures from 1000-1200°F. and discharged at temperatures from 200-500°F. The shale is fed to the kiln at ambient temperature and discharged at temperatures varying from 750-850°F. The shale coke discharged from the pyrolysis kiln is fed to ore cars and dumped. The balls are recycled to a natural-gas-fired ball heating furnace where they are reheated to the desired temperature. All materials entering and leaving the kiln (except the shale-oil vapors) pass through a system of two slide valves operated by a cycle timer. These valves serve to exclude air from the kiln and maintain atmospheric pressure in the kiln itself.

The shale-oil vapors, withdrawn from the bonnet of the pyrolysis kiln, are passed first through an electrically heated dust-settling chamber and then to an air condenser. The resulting



shale oil and noncondensable gases are piped to an oil-gas separating tank, the oil drawn off the bottom, and the residual gases drawn off the top and sent to a flare stack.

Major studies carried out on the Aspeco pilot plant operated under **countercurrent** conditions have included determination of (a) the shale throughput capacity as a function of drum speed and shale feed size, (b) the ball-to-shale heat transfer coefficients as a function of drum speed, (c) the factors affecting degree of pyrolysis, and (d) the extent of grinding of the shale during pyrolysis.

In general, it was found that the shale throughput rate and the heat transfer coefficients both increased with increasing drum speeds, and that the heat transfer coefficients increased with decreasing ball-to-shale feed ratios. The extent of grinding of the shale was found to be a function of both the degree of pyrolysis of the shale and of the power input to the drum. Residence time in the kiln for complete retorting was found to be less than 10 min., which is considerably less than in conventional retorting.

The quality of the oil was in many respects similar to shale oil produced from other processes. The sulfur contents of the oil are of about the same value; however, the nitrogen content of the Aspeco oil is about 25% less and the pour point 10-15°F. less than shale oils produced by other processes.

The original Aspeco patents cover both the countercurrent flow of heated balls and raw shale, and the case of parallel flow (or coflow). At the conclusion of the counterflow studies, therefore, the pilot plant was modified so that balls and shale were fed to the same end of the kiln, and discharged from the opposite end. The ball pickup device was removed, and separation of balls and shale coke accomplished on a grizzly outside the kiln.

The counterflow studies indicated the importance of the mechanical design of the ball pickup device and of the slide valves used to control kiln

pressure. Modifications in these designs are currently in progress.

Some difficulties were encountered early in the counterflow studies with the separation of dust from the oil vapors but were solved by careful design of baffles in the outlet vapor stream. Under parallel flow conditions dust removal was no longer a problem.

On the basis of the technical data obtained on the 25-ton/day pilot plant, the Institute has recently begun a detailed economic evaluation of the entire Aspeco process. This is not the first of such economic studies. A preliminary "order of magnitude" evaluation, based on certain assumptions as to heat transfer rates, capacities, operating costs, and capital requirements was prepared by Aspgren & Co., Stockholm, Sweden, prior to initiation of the development program previously described. Revisions of this estimate have been made continuously, as experimental data have been obtained. These revised estimates have continued to convince the Institute of the economic feasibility of the Aspeco process as a competitive method of oil shale retorting.

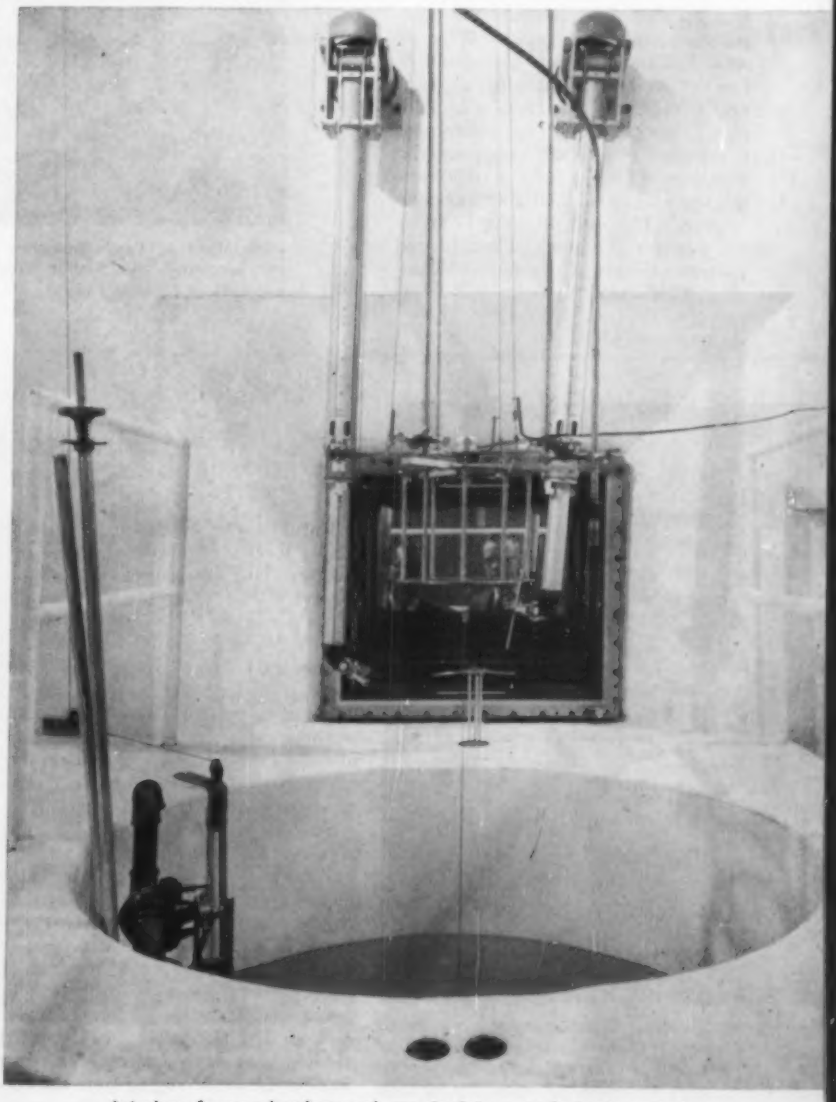
Actual Aspeco plant operation has as is customary revealed the desirability for redesign of certain components. This is particularly true in the case of the ball-handling equipment, where lack of prior industrial experience has required considerable original design.

It is the intent of The Oil Shale Corporation to incorporate such redesign into the present plant during the coming year, to add a scale-up fluidized combustion unit, and to convert the plant into an integrated demonstration pilot plant. Operating data from this revised pilot plant will serve as the basis for a semicommercial plant to be erected later in western Colorado.

The development program on the Swedish Aspeco process of oil shale retorting (covered by basic patents U. S. 2,420,376 and U. S. 2,592,783 is being sponsored at the Univ. of Denver by The Oil Shale Corp. of Beverly Hills, Calif., which owns Western Hemisphere rights to these basic patents. Studies are being carried out under a long-term contract signed in November, 1955. The Denver Research Institute (of the University) is understandably limited, in its discussion of the data presented, to those items which its sponsor is willing to release at this time.

Unique gamma facility

A flexible and unique gamma irradiation facility is in operation in the Department of Chemical Engineering at the University of Minnesota. The installation combines the advantages of pool, cave, and hot cell facilities. The cave is a room 10 by 13½ by 10 ft. high with 4-ft. thick concrete wall and ceiling. A 3-ft. thick viewing window and a pair of master-slave manipulators are in one wall. Entrance to the cave is through a curved tunnel through which large crates (including animals) can be readily handled. The cave ceiling is fitted with a concrete plug which can be removed to permit the introduction of a shielded shipping container. The source material is held in a 5-ft. diam., 17-ft. deep-water well and is raised and lowered by a remotely controlled elevator. The facility is equipped with 2000 curies of cobalt-60 in the form of ten pencils 10 in. long. A variety of source configurations are possible and the maximum exposure dosage for samples is just over 10^6r./hr.

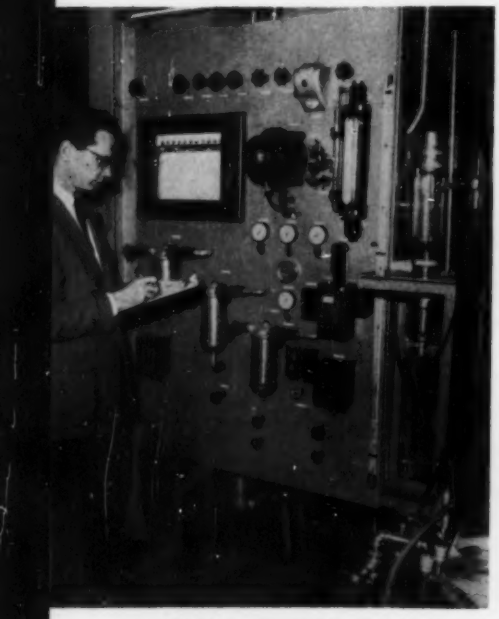


Interior of cave showing pool, manipulators, and viewing window.

Roomsize refinery for operations research

On order is a miniature oil refinery unit designed to save scientific manpower and speed development of new processes to produce fuels of the future at Esso Research & Engineering. To show how compact the computer-controlled pilot plant will be, an artist has superimposed a drawing of the device onto a photo of an engineer's office at the firm's Linden, N. J., labs. The new-type equipment is expected to give oil researchers the data they need to help perfect new processes in about half the time now required. The unit is being built by the Systems Division of Consolidated Electrodynamics Corporation, Pasadena, California.

Pilot plant at Esso Research Labs., Baton Rouge, for study of fluid hydroforming and Fisher Tropsch. Eleven stories high, it has feed capacity of 50 bbls./day.



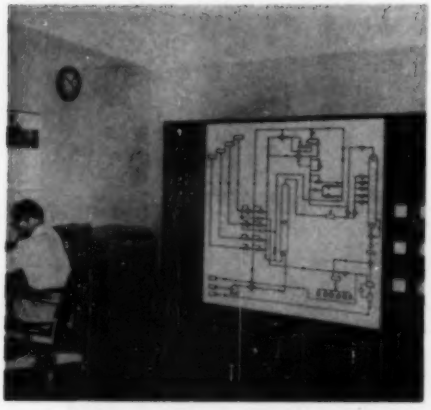
Filtration apparatus which can be operated at either constant-rate or constant-pressure. The apparatus can be used to measure specific filtration resistance.

Hydromechanics of pulp

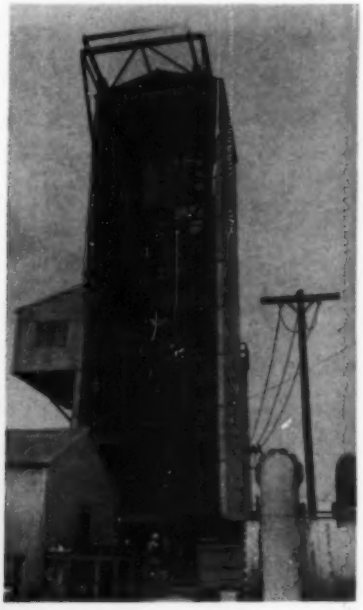
The Institute of Paper Chemistry has for a number of years been working on a long-range project which is concerned with the hydromechanics of pulp slurries. The cellulose-water relationship is generally recognized as an important one in the pulp and paper industry, beginning with the pulping operation, subsequent pulp washing, screening, refining, and finally the forming of a wet mat on the paper machine with eventual removal of water to form the dry paper.

Studies have been both basic and applied. In the former case, interest has been centered on defining and measuring those fiber properties that characterize the relative motion between fibers and water, and determine the resistance of a wet fiber mat to water removal during filtration, thickening, and simultaneous flow of water and air. In the latter case, applied studies have been concerned with a number of areas ranging from the correlation of hydrodynamic fiber properties with the ultimate strength of a sheet of paper, to prediction of the rate and magnitude of water removal on the paper machine. Although there has been some success in developing concepts and applying them to paper machine operation, it is realized that the phenomena dealt with are extremely complex, hence a relatively long period of work is now envisioned, i.e., from five to eight years. Some features unique to these studies are the non-Newtonian behavior of aqueous suspensions of fibers and the viscoelastic nature of wet pulp mats.

Picture (left) shows a filtration apparatus which is usually operated either at constant rate or at constant pressure. The apparatus can be used to measure specific filtration resistance and to determine fiber specific surface, specific volume, and wet pulp mat compressibility. W. L. Ingmanson, chief, Chemical Engineering Group, checks the results of a test run in this picture.



Miniature oil refinery unit being built for Esso R&E.



Fluidized solids pilot plant at Esso R&E, Linden, N.J. 45x5 ft. reactor is in six removable sections, studded with a total of 200 sampling portholes. Air rate is 8,000 cu.ft./min. United is electronically instrumented.

New spurt for dialysis

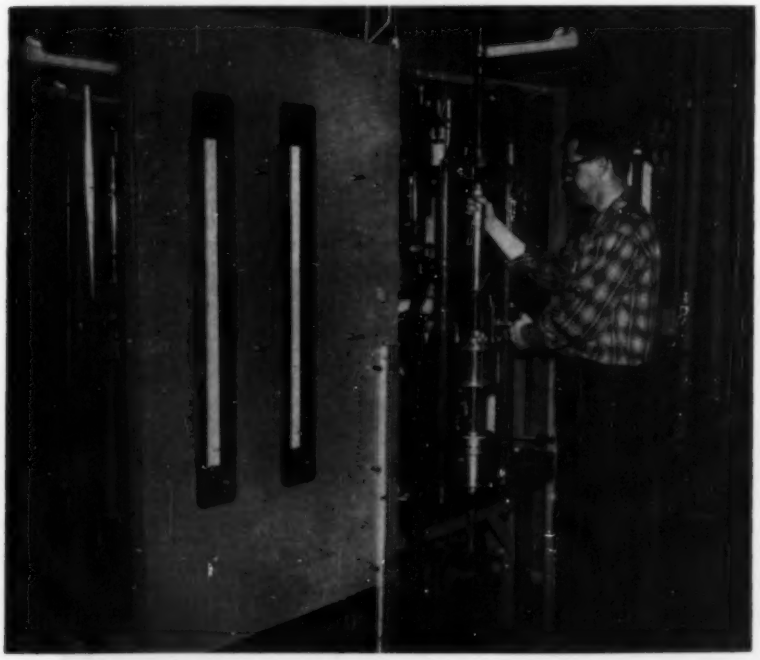
Discovery by National Aluminate Corp. technologists of methods of forming continuous pores of very small diameter in non-cellulosic type plastics, promises to provide a new source of dialysis membranes which should give new impetus to the wider use of dialysis as a unit operation.

Films with pore volume fractions up to 70%, and pore diameters up to 100 Angstroms, have been made while retaining strength and structure of the plastic material. In addition the walls of the pores can be rendered polar or nonpolar depending on the applications for which they may be used.

Present research is centered on extending the spectrum of pore sizes. Eventually it is hoped to have these plastic sieves capable of separating ions according to their size.

Use of these films as carrier and transfer agents, or as filters for gas streams, suggest themselves.

Sample of new dialysis film held by Nalco technologists.

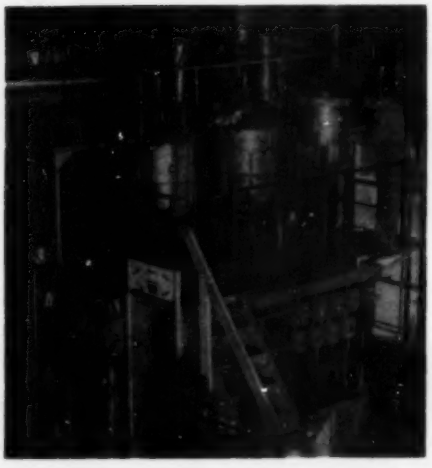


In the central part of this picture is the flow chamber that can be used to study flow properties of fiber systems at various degrees of mechanical compacting pressures.

Another small pilot plant developed at Battelle for the processing of monazite sands to recover Th, U, and rare earths. Sands are treated with strong caustic to decompose the metal phosphates, separate Th, U, and rare earth values, and recover appropriate products. Trisodium phosphate is a by-product in this reaction.

New metals succumb to chemical engineering techniques

An intensive program is under way at Battelle Memorial Institute on the application of chemical engineering techniques to the development of improved processes for the production of metals. The program includes processes for the utilization of low grade ores and for the production of high purity metals, continuous operations, and lower cost processing.



A small pilot plant at Battelle for the production of nickel and cobalt by hydrogen reduction of their aqueous solution. Reaction vessels and supply tanks are shown on the upper level; in the enclosure below is the autoclave where the reduction is carried out.

The high pressure aqueous leaching, by carbonate solutions, of uranium ores. Pressure for the system is obtained hydrostatically. The 5 towers shown in series are equivalent to one tower, 60 ft. tall.

Small mixer-settler pilot plant at Battelle for the solvent-extraction purification of thorium nitrate.

A pilot plant at Battelle Memorial Institute for the reduction of metal oxides to metal with hydrogen in a fluid bed.

Bulldozer + polyethylene film = waste water storage

Giant storage unit of polyethylene film

Two giant polyethylene sheets have been used to form a unique 900,000-gallon storage unit which solves the problem of how to temporarily store waste process waters at U. S. Industrial Chemicals Co.'s zirconium plant at Ashtabula, Ohio.

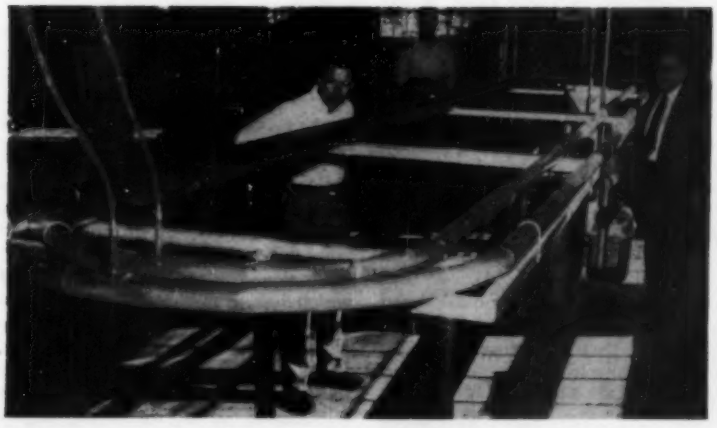
Polyethylene sheets are made up of several strips sealed together. They are installed in a pit 150 ft. long, 100 ft. wide and 8 ft. deep, serving as a liner and cover, and locking in any odors which might make storage in conventional pits undesirable. Waste is pumped through a pipe extending into the pit. A drainage pipe is included for eventual disposal of the waste, after sufficient time is allowed for solids to settle out.

Sheets were constructed from 20 ft. wide strips of 6 mil film. A film containing carbon black was selected to guard against adverse effects of ultra violet rays from the sun. Special portable heat sealing equipment was used to piece the strips together. Due to the unusual dimensions of the overall sheets, a gymnasium had to be rented for the sealing operation.

In use for almost a year now, the unique storage system has proved highly successful. Rain waters accumulating on top pose no problem, eventually seeping through small drainage holes and into the bag. These same holes act as vents for accumulated gases.

Hydraulics of gas-liquid contacting trays is a project at Univ. of Oklahoma under direction of Prof. O. K. Crosser (right).

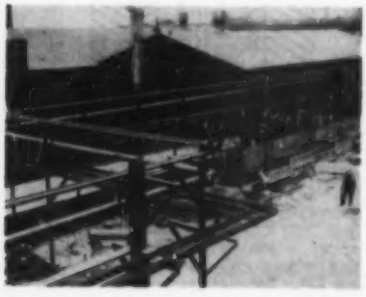
Hydraulics and flow at Oklahoma



Co-current multi-phase flow of fluids in inclined tubing is studied in this equipment. At left are Brigham and Holstein, right is Prof. R. L. Huntington.

Induction heating for sodium lines

Sodium lines to and from sodium storage tanks at the U. S. I. sodium plant at Ashtabula, Ohio, are heated by induction. Shown in the accompanying picture is only a portion of the long induction-heated lines used for piping sodium.



Induction heating used for sodium transport lines.

Petroleum study project at Cal Tech covers fundamentals

B. H. Sage and W. H. Lacey
California Inst. of Technology, Pasadena, California

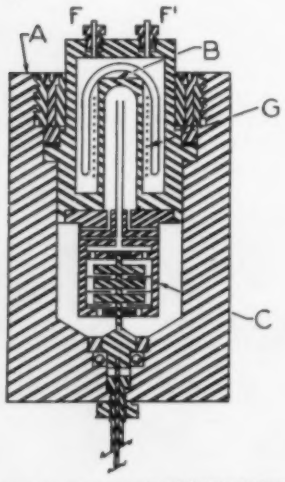
For three decades the California Institute of Technology has been engaged in a project† of learning something of the physical behavior of fluids encountered in petroleum reservoirs. Primary emphasis was devoted to the equilibrium behavior of such systems.

In the early years of the project's life investigations were carried out at temperatures between 100-220°F. and from one atmosphere to 3000 lb./sq. in. At present, measurements range from 40-460°F. and from substantially atmospheric pressure to 10,000 lb./sq. in.

P-V-T relations at phase equilibrium for hydorcarbons and their mixtures have involved the study of some 30 different binary systems and one ternary system carried out by two different methods.

One method uses variable-volume equipment, as shown at right. The hydrocarbon is confined in the vessel C and the effective volume of this chamber is varied by the introduction and withdrawal of mercury. The magnetic clutch P, agitates the system and drives the rotating cage shown in the vessel C. This apparatus has been in nearly continuous use for more than 25 years and is now being revised to permit an extension of work to pressures up to 25,000 lb./in.

† *Project 37 of American Petroleum Institute*



General arrangement of heated-thimble equipment for supersaturation studies

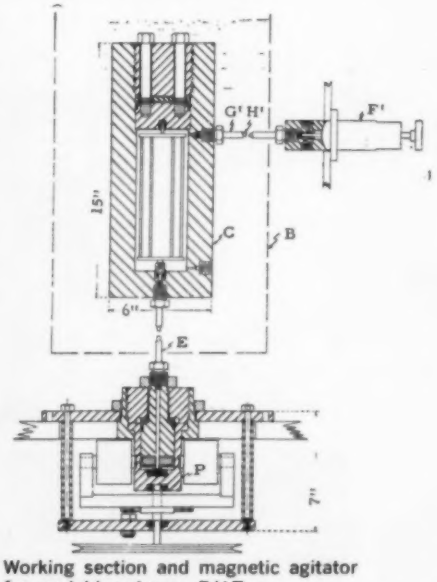
The **second method** of investigating the volumetric behavior of fluids makes use of isochoric equipment and glass capillaries suitable for use in a centrifuge to permit the separation of solid or plastic phases from hydrocarbon liquids at elevated pressures. A fixed weight of material is introduced and the pressure is determined as a function of temperature.

Heat capacities, enthalpy change upon vaporization, and the determination of partial enthalpies of components in hydrocarbon liquids have been determined by calorimetric techniques involving isochoric vessels. The heat capacity of gaseous hydrocarbons has also been determined by means of isentropic expansion of the gas from one pressure to another.

Viscosities were determined, early in the 1930's with a rolling-ball viscometer of the type first developed by Flowers. It was found that solution of relatively small quantities of hydrocarbon gases markedly decreased the viscosity of hydrocarbon liquids. Attempts were made to use the rolling-ball viscometer to determine the viscosity of gases but this did not prove particularly satisfactory. At the present time, a rotating-cylinder instrument is used for this purpose.

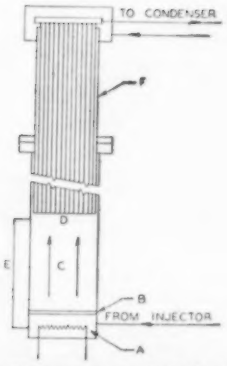
The Fick diffusion coefficients of the lighter hydrocarbon gases in hydrocarbon liquids, are determined as a function of time as diffusion into the liquid phase occurs. Such a transient method is susceptible to relatively simple analysis for situations in which the quantity of the diffusing component is less than approximately half of that required for equilibrium at the new state. Measurements are carried out usually over a series of relatively small changes in composition of the liquid, and thus the effect of the total composition of the system upon the Fick diffusion coefficients may be found. There is nearly a 100-fold change in the Fick diffusion coefficient for methane between the behavior in the liquid phase of the methane-n-butane system and that in the methane-white oil system, the latter involving a heavier component of average molecular weight of approximately 300.

Another method (far right) is used for determining the **transport of hydrocarbons in the gas phase.** Here, the diffusing hydrocarbon is introduced as a liquid at a known rate beneath the porous disk B at right and is evaporated under isothermal conditions into the quiescent gas phase in chamber C. Heater A is employed to maintain the temperature at the interface of the disk B at a constant value. Gas is circulated downward through the tube bank F and upward in the interstices between the tubes; and this gas is maintained at such a composition as to impose a constant composition gradient between the evaporating surface of the disk B and the lower end D of the tube bank; thus permitting steady-state measurements of the Maxwell diffusion coefficients of hydrocarbons of intermediate molecular weight through hydrocarbon gases.



Working section and magnetic agitator for variable-volume, P-V-T

Recently the project has been concerned with the extent to which **supersaturation** may play a role in reservoir fluids behavior. Diagram, left, illustrates the type of equipment which has been developed for measurements of the time required for the formation of a bubble in a supersaturated solution. In this instance the local portion of this system at B is maintained at a somewhat higher temperature than the main body of the system, which is at C. A three-



Schematic arrangement of steady-state, gas-phase diffusion equipment

stage centrifugal pump at C circulates fluid through the chamber B while the system is in the condensed liquid region. Pressure is then decreased until at the temperature existing in B, the liquid is under strain and the time required for the appearance of the first bubble is determined. Such equipment is limited to studies for which an increase in temperature causes an increase in bubble-point pressure. It has been found that both pure hydrocarbons and mixtures can be subjected to significant strain without the immediate appearance of a bubble. The appearance of a bubble in a supersaturated liquid apparently is a process that is random in time and follows Poisson's distribution.

Perhaps the most significant experimental fact established during the life of this project has been the importance of **retrograde condensation in the recovery of petroleum.** It was found that as the pressure is increased at formation temperatures, the relative quantities of the hydrocarbons of high molecular weight in the gas phase increase and in many instances, systems which would exist in two phases at surface conditions actually exist as a single phase underground. Knowledge of this behavior has resulted in important modifications in production methods including such techniques as repressuring, pressure maintenance, and gas-displacement. Knowledge of the phase behavior and diffusion coefficients of the lighter hydrocarbons is of particular importance in the application of miscible-phase displacement techniques which are now being investigated as improved methods of recovering petroleum from underground reservoirs.

At the present time the project is actively engaged in the study of the transport properties of the lighter hydrocarbons in the liquid and gas phases and in studying the behavior of supersaturated hydrocarbon liquids.

Rotary filter uses endless belt

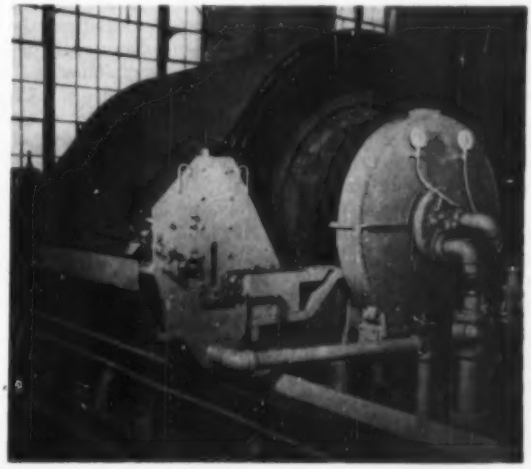
A new-type rotary filter developed to bridge the gap between the continuous precoat drum filter and the standard drum filter, is believed to have many advantages of both. It is similar to the precoat filter, but a cake much thinner than that necessary on a conventional drum may be readily discharged. On the other hand, truly continuous operation is possible.

Its name, "Rotobelt," is derived from the fact that the drum cover, rather than being caulked in place, behaves much like an endless belt. The filter septum is withdrawn from a standard drum filter near the top of the drum's arc after the drying of the filter cake. Then the belt travels from the surface of the drum to a small diameter discharge roll, beyond the edge of the filter tank. By the bending of the filter septum over the relatively small diameter discharge roll, cake discharge occurs as the weight, momentum, and physical shape of the filter cake force this material to be discharged, rather than be returned from the roll with the belt.

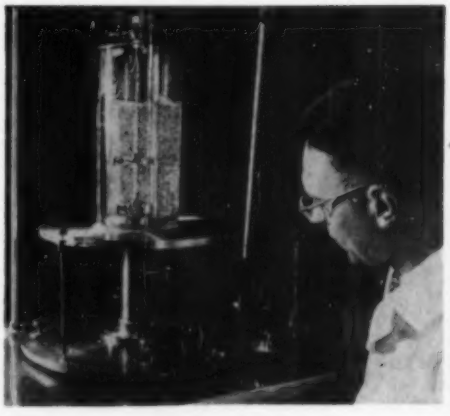
In the event any particles of solid have adhered to the filter medium, these are removed by spray nozzles which wash both the front and the back of the filter cloth. Before the filter medium is returned to the drum, it is rinsed in a wash trough which may be chemically treated if such is desired. The filter septum receives one more spray wash before returning to the drum. Self-aligning rollers insure correct filter cloth return.

A vacuum seal to the filter drum is accomplished by a rubberized edge on the traveling belt.

—The Eimco Corp.



General view—Belt is continuously cleaned by sprays and wash trough. Discharge trough, foreground.



Measurement of agitator horsepower in gas absorption studies

G. A. Brown is determining power input to an agitated system by use of a torque table. Power requirements to give the necessary gas transfer rates are determined in this fashion by Merck Sharp & Dohme Div. of Merck & Co., Rahway, N. J.

New coding system enables engineers with no computer experience to instruct UNIVAC

Univac Math-Matic program is developed on blackboard.

A new system of automatic programming called Univac Math-Matic enables the engineer to solve mathematical problems by stating them in terms familiar to anyone who understands algebraic notation. The simple statement of the problem, using the new system, enables the computer to produce a complete program of machine-coded and debugged instructions for its solution. Thus, it is now said to be possible for engineers and scientists with no programming experience to use either Univac I or Univac II quickly and efficiently for scientific calculations.*

This new automatic programming system is the product of over six years of programming research and application testing, which produced four earlier systems.

Like many other Automatic Programming Systems, Math-Matic employs a so-called "pseudo-code" in place of the normal machine code. Unlike others, however, its pseudo-code is *made up only of English commands and mathematical notations*, providing a system which is quickly learned and easily remembered. It is also an extremely concise system. A very few, short commands will produce a host of machine-coded instructions. These are stored on magnetic tape in what is known as a "library" of computer subroutines. These subroutines are skeletal portions of coding which have previously been produced by skilled programmers and used by the computer to solve mathematical problems. In aggregate, they represent all the instruction steps needed for virtually any mathematical calculation: the combined product of many years of user experience in programming thousands of mathematical problems. All that is needed is to compile, in correct sequence, the segments needed for each individual problem, and to adjust them for whatever variables may be involved. This is done by Univac using the Math-matic System. And, since all the subroutines in the tape library have been previously de-bugged in computer runs, the program which the computer compiles is said to be free of coding errors. Thus, the Math-Matic System offers, to the engineer who is a non-programmer or an inexperienced programmer, the previously worked-out product of highly-trained programmers.

Briefly, the system operates like this: First, the problem is stated in Math-Matic pseudo-code and typed onto magnetic tape with a Unityper. From the tape, the pseudo-code is fed into the computer, along with the tape library of machine-coded computer subroutines and a Master Compiler Tape, both of which are integral parts of the Math-Matic System. The Master Compiler acts as an index which responds to the pseudo-code instructions to call forth, generate, compile, and assemble the various subroutines of

EXAMPLE OF MATH-MATIC TRANSLATION OF PROBLEM

PROBLEM: Calculate (1) the hydrolysis constant, (2) the degree of hydrolysis, and (3) the hydrogen ion concentration for solutions of various compounds at ambient temperature.

1. The hydrolysis constant, K_h, is given by

$$K_h = \frac{K_w}{K_a}$$

where K_h is the hydrolysis constant
K_w is the ionic product of water
K_a is the ionization constant of the compound.

2. The degree of hydrolysis, X for 1 g.–mol of the compound dissolved in V litres of solution is given by

$$K_h = \frac{X^2}{(1-X)V}$$

$$X^2 + XK_hV - K_h = 0$$

$$X = \frac{-K_hV + [(K_hV)^2 + 4K_h]^{1/2}}{2}$$

3. The hydrogen ion concentration is given by

$$pH = \tfrac{1}{2}pK_w + \tfrac{1}{2}pK_a + \tfrac{1}{2}\log c$$

where $c = \frac{1}{V}$; $K_a = \log\frac{1}{K_a}$

The ionization constants, K_a, and the litres, V, per 1 g.–mol of the compounds under investigation comprise the input data of the problem. These values followed by a sentence of Z...Z's will be typed onto tape and used for the problem run.

Instructions for UNIVAC, to be "typed" on magnetic tape by Unityper:

(1) KW = 1•10^{-14}.
(2) PKW = 14.
(3) Read KA V if sentinel rewind and jump to sentence 11.
(4) KH = KW/KA.
(5) X = (−KH•V+((KH•V)^2+4•KH)$^{1/2}$)/2.
(6) C = 1/V.
(7) PKA = Log (1/KA).
(8) PH = 0.5•PKW+0.5•PKA+0.5•LOG C.
(9) Write and edit KA V KH X PH.
(10) Jump to sentence 3.
(11) Stop.

the library, producing a finished computer program and a record of the compilations performed. The program can then be run off on the computer, and the problem solved.

In accomplishment, the language barrier between man and machine has been broken so that, in a sense, Univac has been taught to understand English and the language of mathematics. The engineer or scientist is no longer faced with an extensive training period required to master machine coding. Only a few hours are said to be sufficient to learn the simplified instructions of the Math-Matic System.

As the engineer is thus enabled to write his own computer programs without human assistance, programmers are freed for other, more rewarding work.

In one instance, an engineer with absolutely no previous programming experience is reported as having programmed a stress analysis problem with 35 short sentences of Math-Matic pseudo-code. The machine coding was compiled by the computer in just a few minutes, to produce a program of 3,600 instructions which was then run off on the computer, solving the problem within 12 minutes. Another non-programmer is said to have written out a polynomial equation problem in 34 sentences of pseudo-code, producing a machine-coded program of 3,000 instructions which the computer ran off in 10 minutes. A wide range of scientific problems, from matrix error determination (2 minutes of computer time) to a problem of least squares (2 hours of computer time) have been successfully programmed with Univac Math-Matic. And in most cases, the programming time has been found to be no longer than that required for setting up the problem alone in any other method of solution.

*A similar, compatible system, known as Unicode, is under development for use with the Univac Scientific system.

Unitype II, the typewriter-like device which converts typist's keystrokes into taped electrical impulses.

Fractionation studies on a large scale for fifty-four firms

The research and development program for Fractionation Research, Inc., a non-profit organization owned by 54 participating firms, is being carried out in the commercial size research distillation unit and the large simulator (shown below), as well as in industrial columns of the stockholder companies.

The *distillation unit* is 4-ft. in diam. and has a shell length sufficient for 10 trays on 2-ft. spacing. It is equipped with a removable head to facilitate rapid tray changes. The column usually is operated three shifts, five days each week. A complete series of runs with two systems can be completed in this time interval.

The distillation unit may be operated as either a stripper or a rectifier. It is used to investigate flooding, pressure drop, entrainment, hydrostatic pressures, and efficiency characteristics of vapor-liquid contact devices as a function of tray spacing, liquid and vapor load, pressure, and system properties. Windows are provided in the top head and in the shell for observations of tray action.

Binary systems being studied are n-heptane/cyclohexane, isopropanol/water, carbon tetrachloride/propylene dichloride, n-pentane/absorption oil with stripping steam, and water/steam. A multi-component system, propane/n - butane/isobutane/n - pentane/isopentane, also is being studied. These systems cover a very wide range of system properties. In the future, additional binary and multi-component systems will be investigated. Pressures currently used are 40 mm. Hg abs. to 165 pounds per square inch abs. Provisions have been made for studies at pressures down to 5 mm.

Bubble-cap trays and perforated trays with and without downcomers have been studied extensively. Two proprietary devices, the Uniflux tray and the Flexitray, also have been investigated.

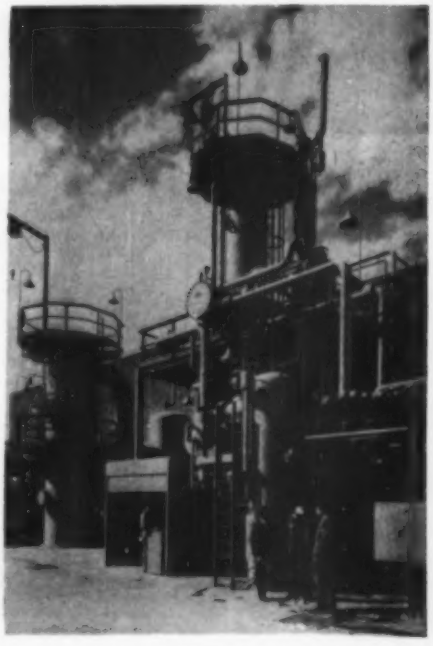
Certain devices to be tested in the distillation unit are first screened in the *simulator* (shown on the left) owned by C. F. Braun & Co. This is a 66-inch diameter, three-tray column. It is used to obtain the same information as the distillation unit with the exception of tray efficiency. In addition, downcomer buildup and vapor distribution data are obtained. Systems such as absorption oil, hexane, or water with nitrogen, carbon dioxide or natural gas are used.

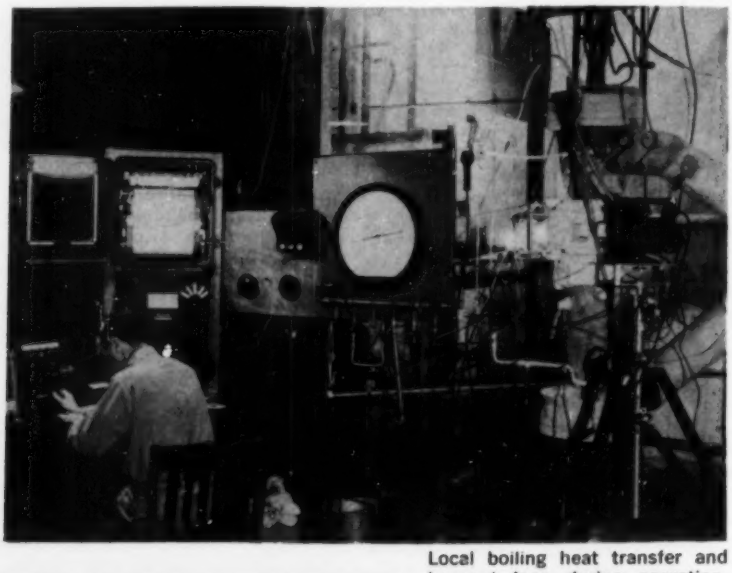
FRI also has carried out extensive studies of perforated trays without downcomers. The term Dualflow has been coined by FRI to describe these trays, which pass both liquid and vapor through the same holes. Dualflow trays of the proper open area have a considerably higher capacity than bubble-cap trays and their maximum efficiency is as high as that of bubble-cap trays. However, they have one serious limitation—the lack of flexibility for some systems.

Another type tray under study is the sieve tray or perforated tray with downcomers. As with bubble-cap trays it has been found that published information on sieve trays is not reliable. In fact, the published design procedures on the sieve tray are largely based on opinions which are misleading and in many respects, erroneous. FRI has developed sieve trays which have a turndown ratio of five to one, a usable capacity somewhat higher than bubble-cap trays and an efficiency significantly higher than bubble-cap trays.

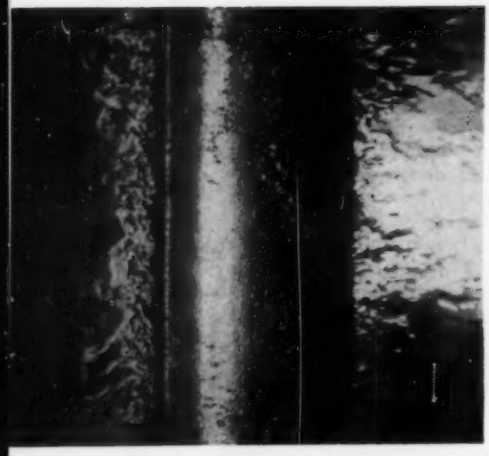
Research data developed by FRI are worked up by a staff of six engineers. This information, in the form of correlations and design procedures, is forwarded to participants in monthly progress reports, topical reports, and design manuals.

66-in. simulator (left) and 4-ft. distillation unit used for benefit of 54 participating firms at Alhambra, Calif.

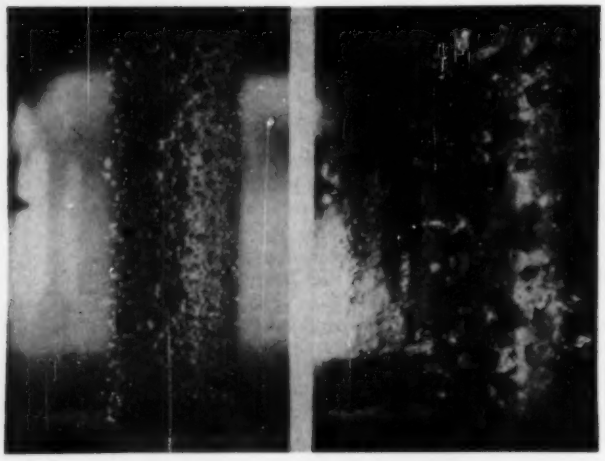




Local boiling heat transfer and burnout loop during operation. High speed motion pictures (up to 14,000 frames per second) of the boiling process are taken with the Fastax camera (right).



View of ½" OD Vertical Nickel Heater seen over 14-15-½" of heated length. Pressure 93.5 lb/sq. in., water temp. 150°F, upflowing water velocity 0.47 ft/sec. Subcooling 175°F. Heat flux 365,000 Btu/hr./ft². Taken at 5 microsecond exposure. Shows front view of boundary layer at left.



View of ½" OD Vertical Nickel Heater seen over 3¾" to 5¾" of heated length. Pressure 92.6 lb./sq. in., water temp. 150°F. Upflowing water velocity 0.13 ft./sec. Subcooling 175°F. Heat flux in left view 600,000; in right 1,230,000 Btu/hr./ft². Taken at 40-50 microsecond exposure. Shows change in subcooled boiling made as heating rate increases.

For Safety in nuclear reactors

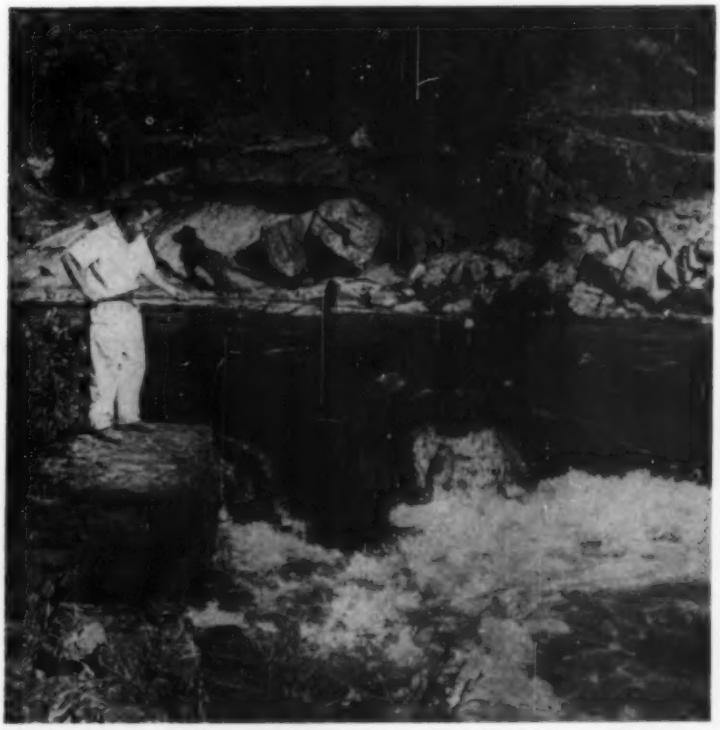
Since April, 1951, the Engineering Research Laboratories of the Dept. of Chemical Engineering at Columbia Univ.'s Engineering Center have been engaged in large scale experimental studies on nuclear reactor heat transfer and corrosion. The purpose of the work has been to ascertain safe thermal operating limits of water cooled or moderated reactors, and to elucidate the fundamental principles of heat transfer in the boiling region. Nuclear heating is simulated by DC electrical heating supplied by a 5,000 HP motor generator set capable of steady state outputs up to 22,000 amperes at 175 volts, and transient outputs of 100,000 amperes over 2 to 10 milliseconds. Versatility of the power supply is necessary to permit full scale simulation of large fuel elements in tests. The tests to date have covered the following range of conditions:

Pressure	15 to 2000 lb./sq.in.
Water Coolant Velocity	0.015 to 45 ft./sec.
Water Temperature	35° to 640° F.
Coolant Channel Geometry	Rectangular, Annular, Twisted Shafts, Inside and Outside Tubes
Heater Lengths	2" to 14'
Heater Metals	Aluminum, Stainless Steel, Zircalloy, Nickel, Copper

Fundamental studies, supported by the Reactor Development Division of the A.E.C. and currently in progress, are extending knowledge of the heat transfer process and burnout as influenced by pressure, subcooling, coolant velocity, dissolved gas content, heater length to diameter ratio, heater metal type, heater surface condition and heater metal thickness.

Radioisotopes . . . new chemical engineering tool

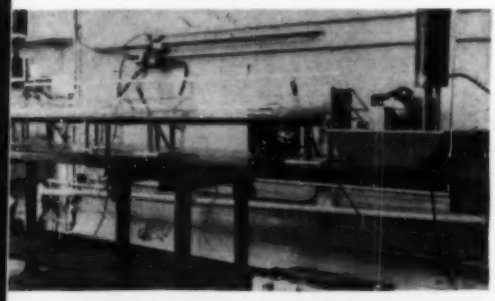
Radioactivity promises to become important in engineering applications according to California Research Corporation, research subsidiary of Standard Oil Company of California. The amount of information obtainable from tracer experiments can be greatly increased by taking into account the appropriate physical and chemical properties of the system under investigation. In addition to the flow measurements illustrated here, radioisotopes have been applied to problems involving flow patterns, leak testing, mixing, separations, and fluid level gauging.



The radiation total count method gauges even large rivers, wherever a turbulent spot can be found to mix in the radioactive tracer. No matter what the shape of the river bed, or where the counter is located in the stream, the total number of counts (taken downstream) tells the flow rate of the whole stream. Short-lived isotopes are used, and are diluted within minutes to a level safe for bathing or drinking.

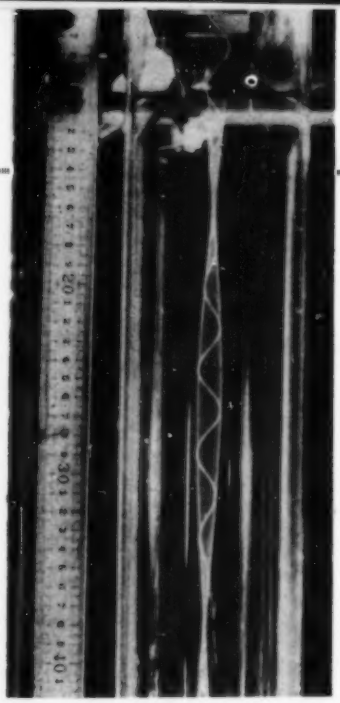
Flow rates may be measured in pipes, even where no flow gauges are installed, by a new radioisotope technique. A nest of Geiger counters is strapped to the pipe, and a bottle of radiotracer is squirted into the pipe upstream. From the total number of counts collected on the scaler while the tracer passes, the number of gallons per minute flowing through the pipe is calculated.

Downstream 500 or 1000 yards, the Geiger counter hangs from a fishing pole on the bank and clicks off the gamma rays from the tracer as it flows past.



Apparatus used in vibrating jet experiments with viscoelastic fluids, in studies under way at Johns Hopkins. Thermostatted reservoir, at right on moving carriage, contains fluid ejected by means of air pressure thru nozzle vibrated by means of an oscillator and amplifier thru an electromagnet. Fluid travels down partially evacuated glass tunnel and is photographed at right angles to tunnel with 2×10^{-4} second flashillumination provided by microflash unit at left.

Vibrating jets, gases through porous media, liquid-solid interfacial reactions under study at J-H

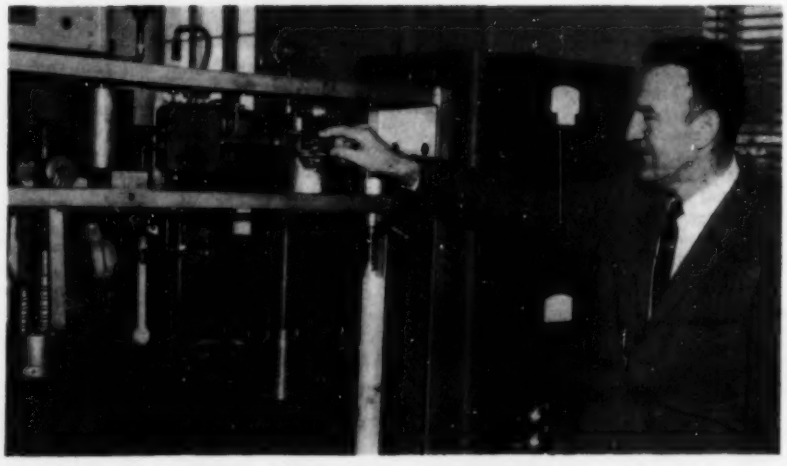


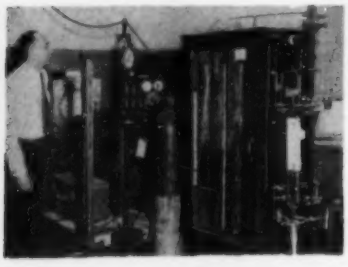
High-speed photograph of typical wave pattern imposed on jet by vibrating nozzle. Picture is time exposure to obtain nodal envelope and superimposed flash to obtain instantaneous picture of traveling wave. By analysis of such wave patterns one may ascertain that the liquid is under tension, much like a rubber band except that the tension decays with time.

Liquid-solid interfacial reactions are studied in this water tunnel, which provides a well characterized and reproducible fluid dynamical atmosphere.

Breakthrough in Gas Separation technology?

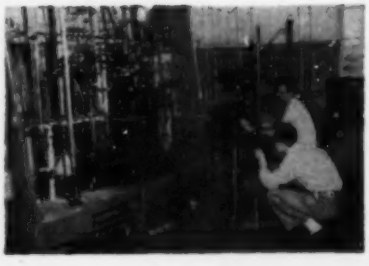
The equipment shown is in use at the University of Texas to study adsorption equilibrium on films of ferroelectric adsorbents under conditions of strong electrical stressing. To magnify the volume of the small quantities of gas involved, measurements are made at low pressure.





With the apparatus shown, in use at the University of Texas, the compressibility factor is being determined for a gas, or a mixture of gases, without knowing the mass, or even the identity of the gas.

One of the two vapor flow calorimeters in the world satisfactory for high precision heat capacity measurements is at the University of Texas. A program of work on the thermodynamic properties of oxygenated organic compounds is in progress.

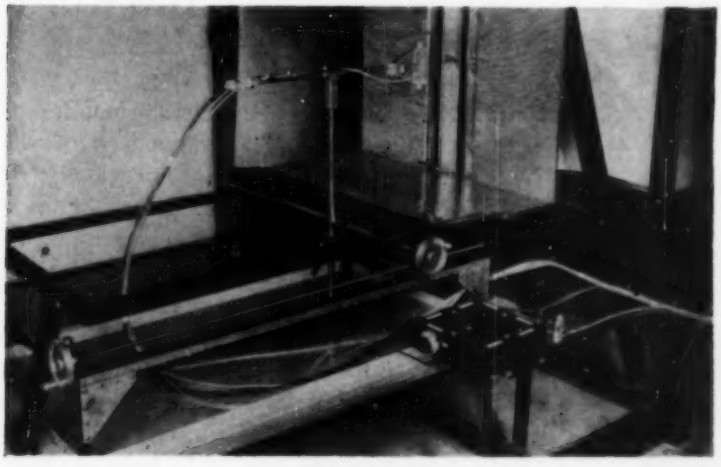


Purdue Research includes studies of free turbulent Mixing with mean pressure gradients

Extensive measurements have been made in the flow fields produced by two parallel two-dimensional air jets and also in the field produced by a single two-dimensional air jet. The measurements include static pressures, flow directions, mean velocities, and turbulence intensities, with nozzle velocity of about 75 ft./sec. Appreciable static pressure variations throughout the fields of both jets were observed. In the case of the dual jets, these correspond with the two inflection points observed in the center lines of the jets as they converge and flow together. In the case of the single jet, they supply evidence that these pressure changes should be taken into account in considering momentum flux changes through various planes perpendicular to the axis.

The electronic components of the hot wire anemometer for turbulence measurements on the left, and the precision micromanometer for pressure measurements on the right.

The two discharge openings for the two jets with a probe in place on the accurate traversing mechanism.



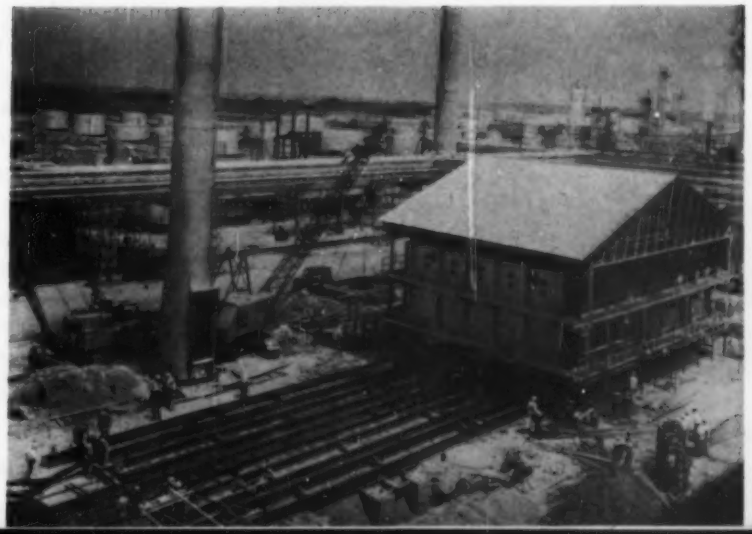
The Rate of Catalytic Hydrochlorination of Acetylene in a Fixed Bed. On a bench scale fixed-bed reactor and auxiliary equipment, the extent of reaction is followed by an analytical scheme based on the difference in thermal conductivity between the reactant and product gases. Thermal conductivity cells, using thermistors as the sensitive elements, have proved satisfactory.

A program is on to relate the rate of reaction to the temperature and the partial pressures of the components of the system.

Student is Vincent Bardin. The project is under the direction of J. M. Woods.

portable heater saves downtime

This 900-ton heater was constructed in 1951 adjacent to the existing heater. When completed, the old heater was dismantled and the new heater skidded into position. Under the conventional method of first dismantling the old heater, preparing new foundations, building the new heater on these foundations, downtime on this project would have been close to five months. On the basis of the Lummus portable heater method, downtime was only six weeks, although the heater cost slightly more initially on a portable basis.



Steam-jet explosion at a geothermal well (Larderello Co., Italy).

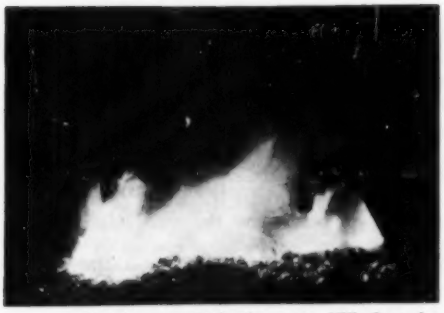
The articles from which the material in this section has been taken, with one exception, will appear in full in Chemical Engineering Around the World, edited by Edgar L. Piret, a Golden Jubilee Volume to be published by A.I.Ch.E. on June 15, 1958.

2.... Chemical engineering around the world

The enunciation of scientific principle appears to be essentially independent of the culture from which it springs, provided that intellectual freedom obtains. It may be more or less rapid, it may seem overcautious or relatively impetuous, it may follow various paths of convergence from guess to hypothesis to theory to law—but the result is the same. Not so for technologies. They will partake of the similarities of the underlying sciences, but equally of the differences that arise from economics and prejudice, local environment, and even fortuitous choice. Engineering, although rooted firmly in science, under the guidance of professional judgment, serves and may create technology. It is susceptible to provincial differences in development, in techniques, even in philosophy of approach. Provincial differences in technology may be an effect, but are more likely to be a cause of different characteristics in engineering practice.

(From an introductory talk to Chemical Engineering Abroad, presented at A.I.Ch.E. Chicago National Meeting, December, 1957, by Shelby A. Miller.)

ITALY



Calcium carbide furnace, Villadossola, Italy.

A particularly ingenious application of the principles of chemical engineering to unique natural resources is the Tuscan borax industry, whose origin goes back to the eighteenth century. At that time, it was recognized that boric acid existed in underground steam issuing from fumeroles in the Maremma region of Tuscany. This was reacted with soda to produce borax. Later, drillings were made which resulted in a steady flow of high-temperature steam. In modern times, this steam has become an important source of electric power through the installation of geothermal electric power stations; such a plant supplied the power for the electrification of the Leghorn-Rome railroad line. At the same time, condensate from the electric turbines is processed to recover boric acid, ammonium carbonate, and liquid and solid carbon dioxide.

Since World War II, as the result of an extensive drilling program, Italian production of natural gas has reached about 4 billion cubic meters per year. Already, about 7.6% of this production is being used as a raw material for an expanding chemical and petrochemical industry. This compares with about 4% in the United States. In addition to methanol, ammonia, and acetylene, already in production, a plant to produce hydrocyanic acid is scheduled for early erection. The chlorination of methane to obtain methyl chloride, methylene chloride, chloroform, and carbon tetrachloride has also been the subject of Italian patents, now extended to the United States and France.

Use of a native material has solved a difficult problem in the construction of electrolytic chlorine-caustic cells. In the De Nora Cell, which has been widely adopted in Europe and the United States, the lining is made of sienite, a natural stone having a low free-silica content, and which can be easily cut into flat, smooth slabs. It is claimed that the sienite is particularly resistant to the chlorine-containing brine, and that cell life has been greatly extended.

Electrolytic plant (Porto Marghera, Italy).

From Italian Contributions to the Progress of the Chemical Industry, L. Morandi and G. Marullo.

Italy—Key to Europe's nuclear power program

Italy may well prove to be the testing ground in Europe for the development of economic nuclear power. Already, in spite of important natural gas finds since World War II, and a well developed hydroelectric system, industrial expansion in Italy is causing power demand to outrun supply from conventional sources. The situation is aggravated by the fact that the country has no important coal deposits.

What is termed by the World Bank a prototype of other installations to follow will be a 150,000 kw nuclear power plant to be erected between Rome and Naples. The World Bank has made available $50 million for the installation which will be owned and operated by SENN, an Italian syndicate of utility companies.

It is reported that competition for the design and building job is intense, with some eleven bids expected to be submitted this spring. Among the competing groups are four American, five British, one Canadian, and one French. Construction is scheduled to be started in January, 1959, and the job is slated for completion in 1962.

Italy has requested that as much equipment as possible for the new plant be built in that country, and U.S. design groups are said to be preparing their estimates to accomodate this request.

That this is only the start of an intensive Italian effort in the nuclear power field is underlined by the fact that several other installations are already in the planning stage, including a $40 million plant in Milan for SELNI, another Italian group.—Ed.

SOVIET UNION

Russian scientists and engineers can claim several important firsts in the development of new industrial processes and their adaptation to large-scale production.

As far back as 1928, Lebedev worked out an industrial method for obtaining divinyl from ethyl alcohol and for its polymerization. The result was the start-up in 1932 of what is claimed to be the world's first large synthetic rubber plant. The production method has since been improved and the yield of divinyl has reached 71-72% of the theoretical value. In addition, copolymerization of divinyl with other components has made possible production of a wide variety of industrial rubbers with various chemical, physical, and mechanical properties.

Note: The article from which the above material has been abstracted also contains a great many production statistics on the Russian chemical industry, an account of Russian research in chemical engineering, a description of the most important Russian books on chemical engineering, and a detailed review of the Russian system of scientific education.

Research, started in 1939 on the oxidation of isopropylbenzene, led to a new scheme for obtaining phenol and to a large-scale plant which went into operation in 1949. With this new method, no additional raw material except air is required and acetone is obtained simultaneously in an amount equal to 65-76% of the phenol produced. The technique can also be used to produce a number of other aromatic oxyderivatives and ketones.

Success was obtained in 1943 in the synthesis of methylstyrene. The method involves production of dimethylphenyl-carbinol from isopropylbenzene. The dimethyl phenyl-carbinol is then subjected to catalytic dehydration to yield alpha-methylstyrene. By rectification, alpha-methylstyrene with a purity of 99.5-99.8% is separated from the mixture obtained. The first plant of this kind was started up in 1953.

Ethylene with a purity of 97-98%, furnished by the petroleum refining industry, is the raw material for several large Russian plants for the direct hydration of ethylene to ethyl alcohol. The techniques employed are the result of Russian research going back as far as 1930-32.

The problem of the industrial production of aniline by the gas-phase catalytic reduction of nitrobenzene by hydrogen has recently been resolved successfully in studies carried out at the Organic Intermediates and Dyestuffs Research Institute. Aniline of a high degree of purity is obtained in high yield by means of a newly developed type of catalyst.

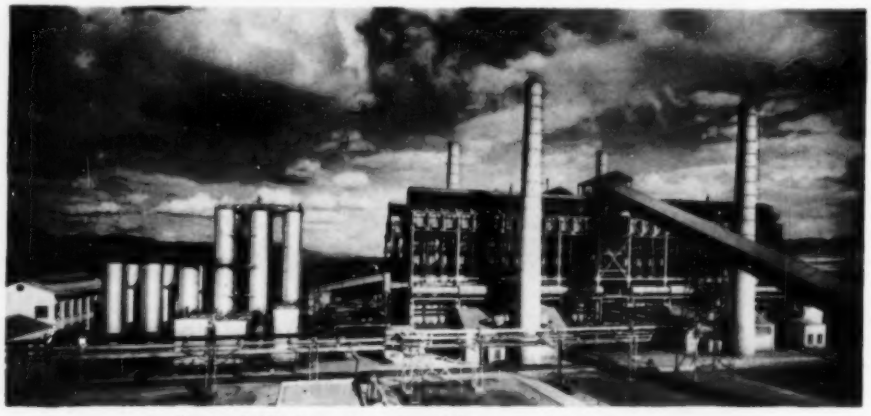
Fluidized bed techniques have come in for much attention in Russian chemical engineering. For example, a reactor has been developed which uses a fluidized powder-form catalyst for the oxidation of naphthalene to phthalic anhydride. An interesting feature of the design is a cooling section surrounded by the fluidized catalyst, where the heat of the reaction is removed by boiling water.

SPAIN

The center of a reviving Spanish metallurgical and chemical industry is the new industrial center at Aviles, in Northern Spain, founded by Empresa Nacional Siderurgica. The main plant will produce 700,000 tons a year of iron and steel ingots, laminated and forged steel, etc. Raw materials will be 2 million tons of native iron ore a year and pyrite roasting wastes from a 200,000 ton per year ammonium sulfate plant.

Use of pyrite wastes involves the recovery of copper and other valuable materials; this problem will be solved by a chloride roasting followed by leaching.

The gases from the coking operation, after purification and carbon dioxide separation, will be distilled at low temperature to produce four cuts: methane and carbon monoxide, ethylene, ammonia synthesis gas, and benzene.



Shale distillation plant, Puertollano, Spain.

There is as yet no real petrochemical industry in Spain. Formaldehyde and some of its derivatives are produced but, generally speaking, there is little diversification. The Aviles plant will aid the situation greatly by providing a source of ethylene and by substantially increasing the national production of benzene.

The most highly developed sector of the Spanish chemical industry is probably the pharmaceutical; there are two plants for the production of antibiotics (penicillin, streptomycin), with enough capacity to permit export, and other companies are making considerable quantities of alkaloids, glucosides, hormones, and vitamins.

Adapted from Chemical Engineering in Spain, A. Rius.

The upper part of the reactor contains a porous ceramic-tube filter for separating catalyst dust from the reaction products.

A second important application is a process already in operation for the gasification of low-grade fuels in fluidized bed gas generators of 20,000 to 40,000 standard cubic meters per hour capacity. Oxygen-enriched air is used, the temperature in the fluidized bed is about 950°C, while the temperature in the gas and dust stream over the bed reaches 1,100°C. In gasification of brown coal, thermal efficiency is as high as 88%.

Development by Kapitsa of an effective turboexpander made possible the practical application of the so-called "low pressure refrigeration cycle" which permits separation of gas mixtures, including separation of air into oxygen and nitrogen, with minimum power expenditures. The method has found wide use for the production of technical grade oxygen in a number of foreign countries.

Adapted from Chemical Engineering and Education in the U. S. S. R., N. M. Zhavoronkov and A. N. Planovsky.

NEW ZEALAND

Chemical engineering in New Zealand is an example of the adaptation of specialized technical skills to the requirements of a predominately agricultural and pastoral country. A New Zealand invention in the dairy industry, for instance, has been adopted widely in the country and its use has now spread to Australia, Great Britain, and the United States. This is a device known as a "Vacreator," which removes from butter undesirable flavors imparted by certain plants. In the Vacreator, a small amount of steam is injected into the cream, and the mixture is then flashed into a cyclone at low pressure. Here, the excess steam and strong flavors are removed and the cream is cooled.

Vacuum dehydrator for meat, New Zealand.

An unusual resource in New Zealand is geothermal energy. A power station of 70-megawatts capacity is now being built. The main chemical engineering problems are separation of the water from the steam, prevention of corrosion from the sulfurous and other gases, and the prevention of silica deposition in the equipment. All of these problems are under active study. In addition, some of the salts dissolved in the geothermal waters have commercial possibilities; investigations are under way looking to the economical extraction of these materials.

From Chemical Engineering in New Zealand, G. M. Smith.

ICELAND

Although Iceland has no coal, oil, or natural gas, she probably leads the world in available energy per capita, leaving atomic energy out of consideration. The secret is geothermal heat.

Natural heat has already found considerable application in Iceland, especially in space heating. The city of Reykjavik receives 35,000 gallons per hour of natural hot water at 175°F from wells 10 miles distant. The greatest amount of energy, however, is available within the limits of the steam fields, and appears as wet natural steam. It is expected that this natural steam will find future application in the recovery of salt from seawater, the production of heavy water, the production of alumina from bauxite, and in various other industrial operations where low-potential heat may be utilized.

Interesting work has been in process recently on recovery of sulfur directly from the natural steam; this is being carried out in the Namafjall steam field where the hydrogen sulfide concentration of the steam is higher than elsewhere. To recover the sulfur, it is first necessary to separate the noncondensing gases from the steam. At Namafjall, the condensation technique involves a high-temperature cooling pond, the steam being condensed by direct contact with self-circulating water from the pond. The pond itself is made of concrete and the condenser of plate steel. Studies on the absorption of hydrogen sulfide by the cooling water proved that, at an inlet temperature of 170°F and an outlet temperature of 206°F, hydrogen sulfide recovery is 85%. Final condensation of water vapor is done by indirect cooling. In the sulfur conversion unit, the gas is burned with air in a simple gas burner. The products are then cooled in a conventional steam generator unit lined with heat-resistant brick, and then led through a catalyst bed, as in the modified Claus-Chance process for sulfur recovery. Direct conversion in the burning process gave a yield of about 80%; use of a catalyst raised this to approximately 90 per cent.

Pilot plant for recovery of sulfur from natural steam by the modified Claus-Chance process.

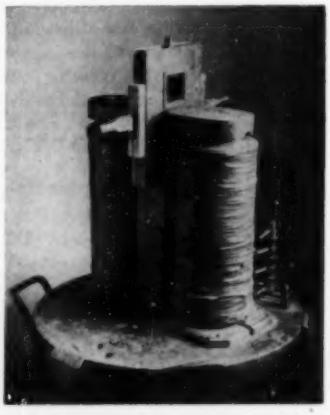
From Process Development in the Application of Natural Steam, B. Lindall and H. B. Kristinsson.

NORWAY

Norway can boast of several important firsts in the history of chemical engineering. High among these must be ranked the first commercially successful production of nitrogenous fertilizers from atmospheric nitrogen, carried out in Norway about the turn of the century. Second only to this was the Norwegian invention of titanium dioxide pigments and the development of a commercial process for their manufacture.

Based on extensive forest reserves, the Norwegian pulp and paper industry is large and progressive. By the end of 1958, Borregaard, largest Norwegian pulp and paper company, expects to have in operation the first commercial-scale plant using the Zimmermann process for the recovery of heat and energy by the complete wet combustion of the organic material in waste pulping liquors. The process will operate at a pressure of 150 atmospheres and a temperature of 300°C. The turbocompressor will use 26,000 hp; this energy will be obtained by expanding the hot gases from the process through a gas turbine, and the steam produced through a back-pressure turbine. The plant is expected to produce about 100 tons of steam per hour, which represents a saving of from 50,000 to 60,000 tons per year of imported fuel oil.

From Chemical Engineering in Norway, S. G. Terjesen.



Original apparatus used by Birkeland for the fixation of atmospheric nitrogen.

INDIA

Ammonia synthesis gas from wood, pulp and paper from bamboo, ammonium sulfate fertilizer from gypsum—these are only some of the unusual chemical engineering processes now in operation in India.

At Sindri, in Bihar, there stands one of the world's largest fertilizer plants—one of the few plants to use gypsum as a raw material for ammonium sulfate production, its capacity is about 1,000 tons per day. Ammonia is made by a conventional modified Haber-Bosch process, with synthesis gas being made from coke. Ammonium sulfate is made by the double decomposition of gypsum and ammonium carbonate, the products being precipitated calcium carbonate and ammonium sulfate solution which is processed to crystallize out the product ammonium sulfate.

In Travancore, 50,000 tons per year of ammonium sulfate is being pro-

ISRAEL

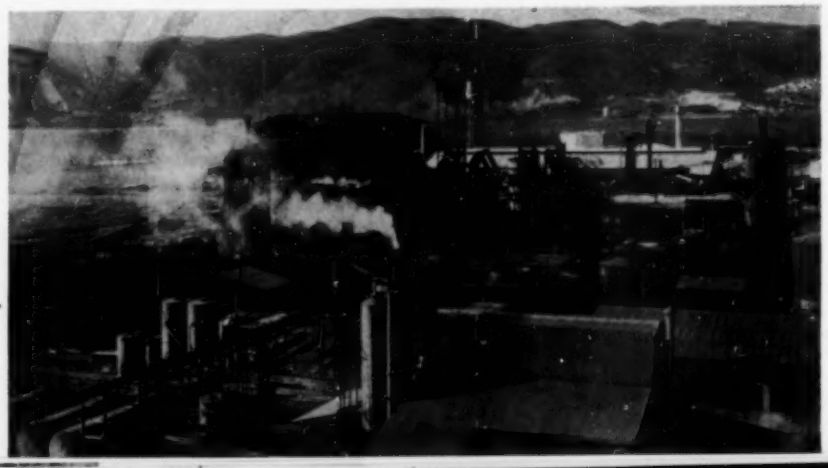
Success is claimed in Israel in the use of hydrochloric acid for the production of phosphoric acid. In Israel, neither of the standard processes for making phosphoric acid can be economic at the present time—the "wet process" because of the consumption of sulfuric acid which must be made from imported sulfur, and the "thermal process" because of the large requirements of fuel, which must also be imported. Hydrochloric acid, on the other hand, is produced locally as a by-product in the upgrading of chlorides, and can be credited at a low value.

Early attempts to use hydrochloric acid for the production of phosphoric had failed because of the difficulty of separating calcium chloride from the product acid. A new approach, under investigation by Israel Mining Industries, involves extraction of the acid with butyl alcohol or a similar solvent. The process has been fully tested in the laboratory and almost completely on a pilot plant scale. Cost estimates indicate that it will be economical.

A new detergent, based on the oxidation of gas oil is being developed. Gas oil (230-290°C boiling range) is dearomatized with oleum; the product is separated from the acid sludge and neutralized. The dearomatized oil is oxidized with air to yield peroxides and carboxylic acids; the products are reacted with sodium bisulfite to give two crude product streams, sulfonate and acid, which are then separated. The unreacted oil is recycled to the oxidizer, and the crude products undergo purification.

The sulfonate is used as a detergent-active material; the carboxylic acids are similar in many of their properties to naphthenic acids, particularly in regard to the formation of oil-soluble metal salts.

From Chemical Engineering in Israel, R. Neuberger.

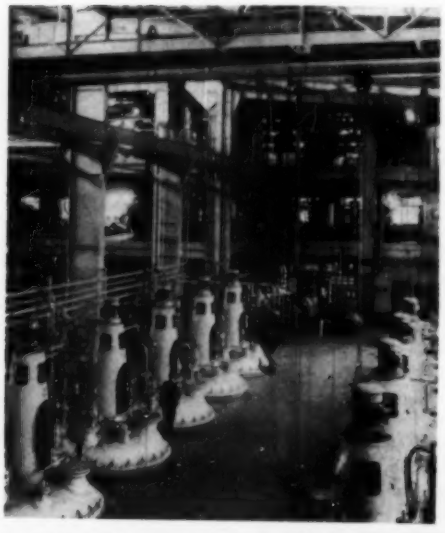


Plant of Fertilizers and Chemicals, Ltd., Haifa.

duced by a unique process in which wood is used for the production of ammonia synthesis gas. Producer gas is made in a battery of six generators, said to be among the largest of their type in the world.

With limited coniferous forests, India has turned to bamboo as a raw material for the pulp and paper industry. Bamboo can be cultivated like sugar cane, with an average felling time of four years. It is estimated that about 3 million tons per year will be available. Present mills in India use a cooking liquor consisting of caustic soda and sodium sulfate as the main pulping chemicals. Tests in the U. S. have shown that commercial newsprint can be made from a combination of salai, a native Indian wood, and bamboo; a 100 ton per day mill started production in 1956.

From Chemical Engineering and Technology in India, M. D. Parekh.



WEST GERMANY

Of all the major industrial powers, West Germany is alone in not recognizing the existence of the special branch of engineering called chemical engineering. This does not mean that chemical engineers of other countries are necessarily very close to the American concept; in some cases, the German alternate to the nonexistent chemical engineer is more nearly like an American chemical engineer than is the chemical engineer in other countries. In spite of this negative attitude, the flourishing condition of the West German chemical industry is too well known to permit any doubt that the West Germans have found adequate means to handle the development of the chemical process industries.

The principal engineer encountered in the West German chemical industry is the mechanical engineer. More recently, the Verfahrens Ingenieur (process engineer), an offshoot of the mechanical engineer, has appeared. In West Germany, the process engineer is considered to be largely an equipment engineer. His chemical engineering training is primarily in unit operations, based on methods quite similar to those used in the United States. The curriculum does not pay much attention as yet to process design, instrumentation, material and energy balances, applied chemical kinetics, or chemical thermodynamics. Only about one hundred process engineers are graduated per year in West Germany, about one percent of all engineering graduates; this compares to three or four thousand in the United States, or about ten percent of the total.

Despite the lack of "chemical engineers" in West Germany, recent German contributions to processing equipment and techniques include the Winkler generator (fluid bed), the Kittel tray, and other novel designs. German mechanical engineers have also made important contributions to the field, as in fluid flow and boundary layer work (Prandtl, Schlichting, von Karman), heat transfer (Nusselt), and fluidization (Winkler).

German work on process has also been outstanding. Going back to the First World War, the Haber process for ammonia was probably the first really continuous chemical process technique in the world. In more recent times, there can be adduced the Fischer-Tropsch and Oxo processes, Bergius coal hydrogenation, Linde low-temperature liquefaction, Buna-S rubber, Reppe acetylene chemistry, acrylonitrile and acrylonitrile fibers from acetylene and HCN, diisocyanates, polycarbonates, and Ziegler low-pressure polyethylene.

From Chemical Engineering in the West German Republic, R. Landau. Given at A.I.Ch.E. Annual Meeting, Chicago, Dec., 1957.

Continuous emulsion polymerization of Buna in W. Germany.

Shale mine with pilot plant in background, Tremembe, Brazil.

BRAZIL

The future of the chemical industry in Brazil depends in large degree on the success of the great present effort to develop the country's petroleum industry, an effort spearheaded by Petrobras, a company formed in 1953 by act of the Brazilian Congress.

The most striking feature of the Petrobras program is perhaps the Petroleum Refinery School, formed to supply engineers for the country's rapidly expanding chemical and petrochemical industry. Candidates for this school are selected carefully from recent graduates of Brazilian universities or from refinery engineers who have had operating experience but no formal training in petroleum refining. All engineers entering the school may, it they choose, become employees of Petrobras. If they accept this financial aid, they are expected to work for Petrobras for at least two years after graduation. After one or two years of refinery experience, the best engineers are usually sent abroad for further training.

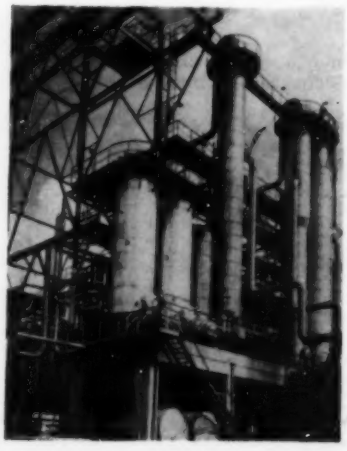
Although the law establishing the Petrobras company does not grant the firm a monopoly in the petrochemical industry, Petrobras is already branching out into that field. A 100 ton per day ammonia plant has been erected to process Cubatao refinery gas by the Texaco partial oxidation process; conversion to ammonia is carried out in a Casale unit. In addition, a new ethylene recovery plant is on stream. The ethylene will be sold to private companies whose plants are being constructed near the Cubatao refinery. Part of the ethylene will go to Koppers' styrene plant, part to Union Carbide's polyethylene plant, and the rest will be chlorinated for insecticides.

A modern shale oil plant has been built at Tremembe, Sao Paulo State, at the site of the Paraiba shale deposits. The plant has already completed studies on the wet Paraiba valley shales (estimated reserves 3 billion barrels) and work is beginning on the shales from the much larger deposits in the Irati valley.

From The Brazilian Petroleum Industry, F. C. Williams, A. S. Moggi.

THE NETHERLANDS

Studies initiated in The Netherlands have led to what appears to be a promising method for the purification of saline and brackish water. The method selected for development was "perm-selective" demineralization; the membranes employed are ion exchange resins in sheet form. Preliminary work indicated probable costs ranging from 30 cents per 1,000 U. S. gallons for slightly brackish water to $1.37 for sea water. In view of these results, eight countries—Australia, France, The Netherlands, The United Kingdom, South Africa, Greece, Israel, and Pakistan—have formed a cooperative association to extend the Dutch research work to a commercial scale. The work is being done by the Organization for Applied Scientific Research in The Netherlands, a government-sponsored body.



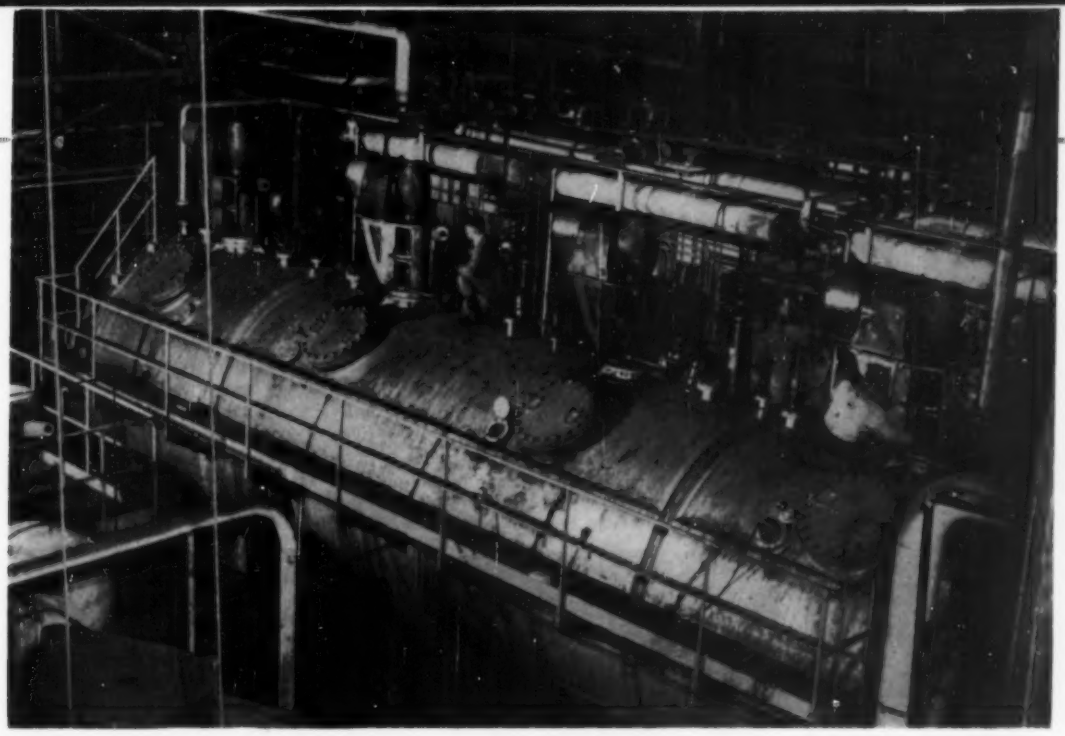
Set of rotating disc contactors in an oil extraction plant.

Investigations by Van Tongeren, which established the existence of a "double eddy current" in dust cyclone operation, have made possible the use of large-diameter cyclones for dust removal, instead of the multiple small units previously employed.

The Netherlands State Mines has made another valuable contribution to chemical processing science—the hydrocyclone, which applies the cyclone to the treatment of suspensions of finely divided solids in liquids; a wide field of application has already resulted, both in mineral dressing and in chemical and petroleum technology.

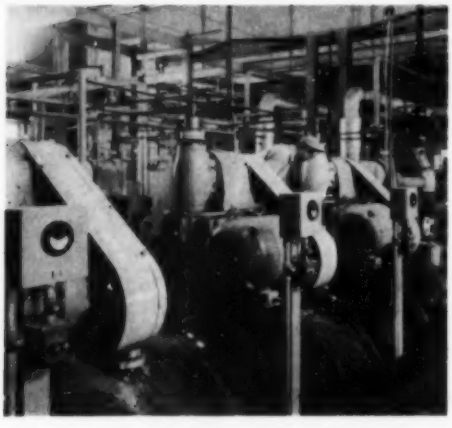
A new type of extraction apparatus, the rotating disc contactor, was developed in the Koninklijke/Shell laboratories in Amsterdam. Already tested in large-scale solvent extraction installations, the unit is said to be highly efficient, simple, cheap to operate, and easy to maintain.

From Chemical Engineering in Our Times—The Netherlands, H. Hoog.



One of eight leaching autoclaves (Sherritt Gordon).

View along a reduction autoclave (Sherritt Gordon).



CANADA

The first large-scale heavy-water reactor in the world, at Chalk River, was the first producer of Cobalt-60 for medical use. The plant was designed and built by Canadian Industries Ltd., with only limited access to atomic energy information held by the U. S. and other governments.

The acid pressure leaching process, worked out by Forward and Halpern for the treatment of uranium ores, is expected to find application in the treatment of many other sulfide ores. In the uranium application, the aqueous ore slurry is treated with air or oxygen at elevated temperatures in a closed reactor; the acid required to dissolve the uranium is generated by oxidation of the sulfides initially present in, or added to, the ore.

The Sherritt Gordon Nickel Refinery at Fort Saskatchewan, Alberta, incorporates a number of original developments in chemical engineering techniques. The refinery treats sulfide concentrates containing approximately 12% nickel, 1.5% cobalt, 0.5% copper, 30% iron, and 28% sulfur, in a continuous leaching operation using ammonia and compressed air.

Nickel, cobalt, and copper are dissolved in solution in the form of complex metal anions. Iron remains with the undissolved solids as ferric oxide and is separated from solution by a series of thickeners and filter. Copper is precipitated as copper sulfide in a continuous distillation and filtration operation. The copper-free solution is first purified in a combined oxidation and hydrolysis operation, using hydrogen as the reducing agent and ferrous sulfate as a catalyst. Nickel powder, precipitated during the reduction operation, is washed, briquetted, sintered, and packaged. The residual metal in solution is evaporated to crystallize and recover fertilizer-grade ammonium sulfate.

From Chemical Engineering in Canada, G. Page.

POLAND

Following the end of World War II, the efforts of Polish chemical engineers have been concentrated on developing methods of production based on native raw materials. A striking example is a new process for production of aluminum oxide and sulfate from deposits of clay (there are no bauxite deposits in Poland.) The product is said to be perfectly suitable for reduction to metallic aluminum.

Coal tar is well on its way to becoming one of the cornerstones of the Polish chemical industry. Poland ranks fifth among the world's producers of coal tar; this combined with the fact that the country possesses practically no petroleum resources, is providing the impetus for a comprehensive program of research into the chemistry of coal tar and its derivatives.

Large deposits of sulfur, which are only now coming under full-scale exploitation, should provide the basis for an expanded effort in production of sulfuric acid and related inorganics. Increased imports of petroleum will enable the creation of an organic chemical industry based on ethylene. Finally, we can look for considerable developments in the production of acetylene and related technologies.

From Chemical Engineering in Poland, J. W. Ciborowski.

Operator at hand dug oil well wearing a protective mask.

BURMA

Oil was the industrial lifeblood of pre-World War II Burma: about 830,000 barrels were consumed in Burma and nearly 5 million barrels went to India annually. The main hydrocarbons present in Burma crudes are paraffins, naphthenes, and aromatics. The asphaltic content is small and only traces of sulfur and other deleterious substances are present. Refining is therefore simple except for separation and production of waxes.

Burma was one of the pioneers in the sweating process for the manufacture of first-quality waxes. In fact, the Alan-Moore Sweating Stove was patented and developed by two executives of a Burma Refinery. This type of stove was the standard sweating plant for a number of years, but has now been largely replaced by the ver-

Women operating an air pump for the driller's protective mask.

Bailing oil from a primitive well by manual labor.

FRANCE

By 1962, France may well be the second largest producer of sulfur in the world, inferior only to the United States in capacity. This startling development is the result of a large recent strike of natural gas at Lacq, near Pau. The present established capacity of the new field is 150 billion cubic meters, about equal to the total capacity of the Po valley fields in Italy. New drillings are said to indicate a westward extension of the field and a total reserve of from 450 to 500 billion cubic meters.

The gas, at high temperature and pressure (10,000 lb./sq. in. and 140° C), contains 15% hydrogen sulfide, 10% carbon dioxide, and 72% methane plus ethane. The first desulfurization plant is now on stream with a rated yearly capacity of 55,000 tons of pure sulfur. By 1962, a sulfur production level of 1,250,000 annual tons is projected.

At that time, the clean gas available to industry from the Lacq field will amount to 4 billion cubic meters per year, equivalent to 6 million tons of coal or 4 million tons of heavy fuel oil. In the next ten years, a tremendous development of the chemical industry in the South of France can be foreseen—in nitrogen fertilizers, acetylene derivatives, synthetic rubber, synthetic plastics, and many other related branches.

It is also possible that a large and regular supply of crude oil will be available by 1960 from the important finds recently made in French territory in the Sahara and in other African parts of the Union Francaise.

From Fifty Years of Chemical Industry in France, J. Cathala

ARGENTINA

A basic petrochemical industry, a large polyvinyl chloride plant, a Freon plant, nylon, polystyrene, and polyethylene projects—all these are evidence that the chemical industry in Argentina is recovering rapidly from the disastrous economic and financial policies of the Peron regime.

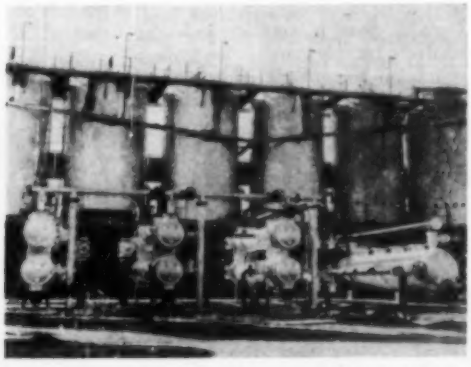
Following the overthrow of the Peron government, the Argentine chemical industry, along with other industries, faces four critical problems: shortage of electric power; shortage of transportation; shortage of raw materials; and shortage of processing equipment. Of these, the most critical is probably the power shortage—all industrial power is now rationed and new industries being installed are, in many cases, forced to import their own power generating equipment. Steps are being taken to correct the situation, but it will be several years before sufficient power

tical-tube stove, also developed in Burma.

In another field, a major research effort is being made looking to the manufacture of paper from bamboo. About 214 species of bamboo exist in Burma. In one locality, there exists a solid block of one species which covers an area of thousands of square miles. There is no doubt that bamboo is an excellent paper material; several Japanese, French, and American firms are now negotiating with the Burmese government with a view to setting up a joint venture. Being a chemical pulp, however, bamboo is too expensive for the manufacture of newsprint. With this goal, research is now being carried out at the Applied Research Institute in Burma on mixing the bamboo pulp with other, cheaper fibers such as bagasse, jute waste, etc., on the possibility of mechanical pulping, and on the redesign of digesters and other equipment.

From Chemical Engineering in Burma, Saw Tun.

A bucket of crude oil coming out of a hand dug well.



Sweating stoves at Chauk oilfield.

stations can be installed.

Transportation of oil and gas is expected to be eased soon by the completion of projected pipelines; the target date is 1960.

Research in chemical engineering in Argentina has not been highly developed. Nevertheless, a new method invented there for the production of calcium tartrate and alcohol from wine lees is now in operation in two European plants, and interesting work has been carried out at the College of Chemical Engineering in Santa Fe on the use of rotary spirals, rotor and stator ducts, and vibratory spirals in distillation and other chemical processing equipment.

From Argentine contribution to Chemical Engineering Around the World, R. Garcia and T. G. Krenkel.

View of cellulose and paper works near Rosario, Celulosa Argentina. Vacant plot of land indicates site of polyvinyl chloride plant now under construction.

SWITZERLAND

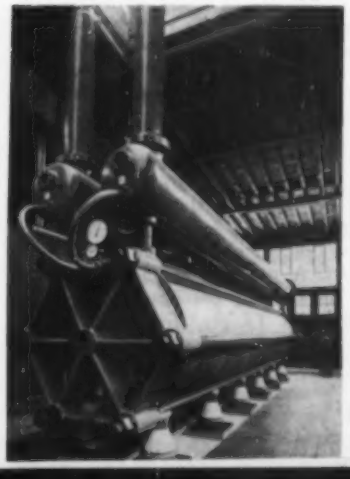
Important recent work has been done in Switzerland on the development of equipment for the production of electrolytic hydrogen. A commercial-scale unit recently tested by Lonza A. G. in Basle consists of a number of framed, cyclic pressure cells, which contain the electrodes and the diaphragms. The apparatus allows of higher working temperatures, with a relatively low current density of 4,000 amperes, and a minimum voltage of 600 volts. The electrical efficiency is as high as 86%. Product oxygen has a purity of 99.8% and product hydrogen a purity of 99.9%. In addition, the hydrogen produced is at a pressure of about 30 atmospheres; thus, if it is to be used for high-pressure synthesis, a great part of the necessary compression work can be saved.

Design and construction of high-pressure compressors is also a specialty of Swiss chemical equipment makers. Of special importance to high-pressure technology are new free-piston, oil-free compressors.

In the field of insecticides, development and production of the most widely known and used compound, DDT, were first worked out in Switzerland. This discovery was the result of long-range research work by Nobel Prize winner, P. Muller.

From Chemical Engineering in Switzerland, A. Guyer.

New pressure-electrolysis unit for production of hydrogen and oxygen.



JAPAN

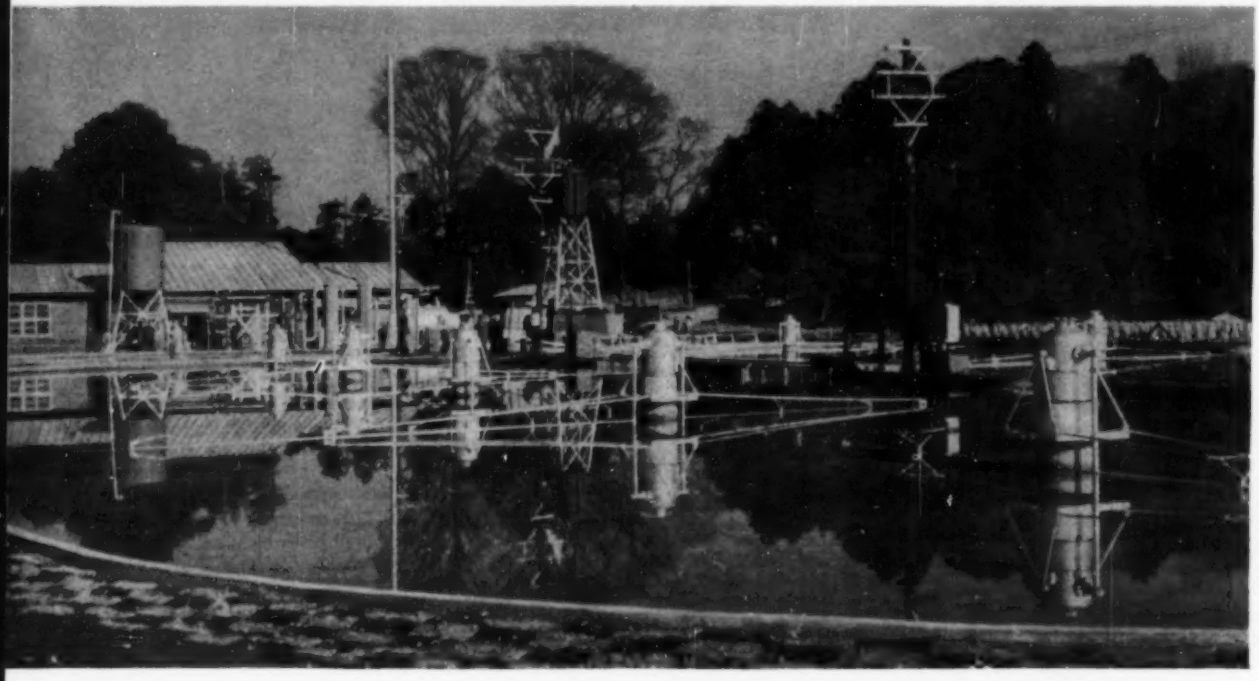
It is probably not universally known that the use of monosodium glutamate to bring out the flavor of foods is a Japanese invention. In 1908, Ikeda of Tokyo University identified the essence of tangle extract, a favorite flavoring medium for Japanese dishes, as the sodium salt of glutamic acid. Production and commercial sale started in the same year under the trade name of Aji-no-moto. Later, wheat flour and soybean were adopted as raw materials; present production is about 850 tons per month, or about half of the world's consumption.

In the course of developing the sodium glutamate process, the necessity of handling hot, concentrated hydrochloric acid forced Japanese chemical engineers to develop acid-resisting linings in order to construct large vacuum evaporators, continuous vacuum filters, and crystallizers. Since World War II, Karbate tubes have been adopted for evaporators and condensers.

Optical glass is another Japanese specialty. In particular, long-range research on the proper addition and dispersion of trace elements such as fluorine has led to the possibility of making lenses of extremely high resolving power.

The pressing need for cheaper and more abundant sources of protein food for the increasing Japanese population has led recently to interesting experiments on the possibility of growing algae (or chlorella) for its food value. Based on progress to date, engineering estimates indicate that 82 acres of ponds could yield 9,100 pounds of dried algae at a production cost of 25.8 cents per pound.

From Japanese Chemical Engineering and its Problems, S. Uchida and S. Fujita.



Chlorella farm, Japan.

BELGIUM

The Belgian fertilizer industry got off to an early start and has continued to lead in the invention and development of processes and equipment. A process for the production of nitric acid, perfected by Societe Belge de l'Azote, featuring atmospheric ammonia oxidation and pressure absorption, can boast of installations in Belgium, Holland, Norway, France, and Israel, with a total production of roughly 2,000 tons per day.

Widely used and licensed in several countries today are wet process phosphoric processes developed by Prayon of Belgium and by Union Chimique Belge in collaboration with Saint-Gobain of France.

In addition to zinc and copper, many strategic metals are produced in Belgium, using processes invented and perfected by Belgian engineers. Of particular note is a process for the extraction of germanium from sulfides of lead, copper, iron, and zinc, a technique due to the Vieille-Montagne Company, and an electrolytic process for high-purity cadmium, also the property of Vieille-Montagne.

Organics have not been neglected. Important and advanced recent work has been done in Belgium in the field of photographic chemicals; the leading Belgian company here is Gevaert Photo Production.

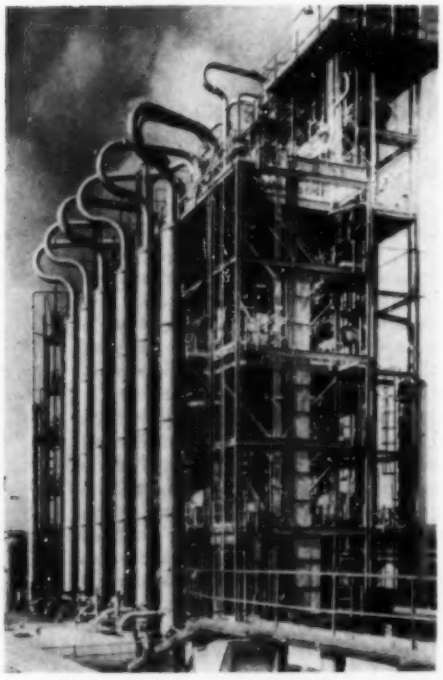
An acetylene process now in actual commercial production in

BRITAIN

From the broad and deep British contribution to the science of chemical engineering, it is extremely difficult, and perhaps unjust, to single out particular achievements for special mention. However, there has been important recent work in Britain, particularly in the theoretical field, which has not been sufficiently known.

In the field of distillation, the work of A. J. V. Underwood has been outstanding, starting with a paper in 1932, in which he coordinated and extended the methods of earlier workers and laid the foundation for the rational design of columns for both binary and multicomponent systems. Subsequently, he developed further equations for binary systems and obtained a solution for multicomponent systems with exact equations for the minimum reflux ratio and the plate compositions. He also applied his equations to a practical design problem and showed how to determine the optimal feed point location.

Distillation columns at Midland Silicones, Ltd., plant at Barry.



Work in the liquid-liquid extraction field was intensified by the shortcomings of existing design procedures when applied to the production of highly purified uranium and the separation of radioactive fission products and of plutonium from spent reactor fuels. Work at Harwell included not only studies of the hydrodynamics and other factors influencing the performance of packed, rotary, and pulsed columns, but also investigations of the liquid-liquid surface itself, using wetted-wall columns, stirred transfer cells, and single droplets. A simple expression common to most, if not all, types of column extractors has been devised and has been used as a basis of methods for the correlation of flood-points for such contactors.

Turning to specific types of plants and equipment: there have been outstanding recent developments in Britain in high-pressure techniques, heat exchangers, pumps, filters, high-vacuum techniques, the all-glass plant, tower packings, anticorrosive plastic materials, and the submerged combustion evaporator.

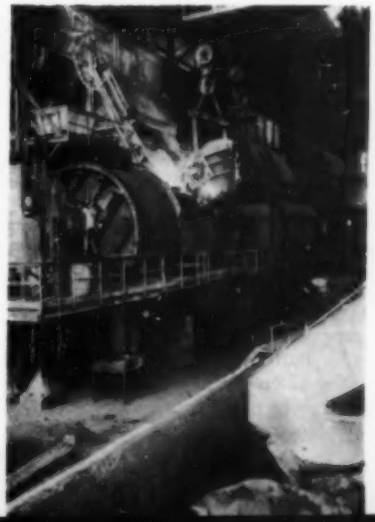
From The British Contribution to Chemical Engineering, H. Hartley

Belgium and France features use of burners completely fabricated of steel without refractories; the method was developed by Societe Belge de l'Azote.

Original work has also been done in pharmaceuticals, particularly in the antihistamines, and more recently in tranquillizers.

From Chemical Engineering in Belgium, C. J. Guillissen and A. Quets.

Copper converter plant, Elisabethville, Belgian Congo.



Chemical Engineering Building, Australian Atomic Energy Research establishment.

AUSTRALIA

The ultimate need for atomic energy in Australia is obvious; there are no native supplies of oil or natural gas and only limited reserves of bituminous and brown coal. On the other hand, uranium ore is mined at Radium Hill in South Australia and at Rum Jungle in the Northern Territory. Treatment of deposits at Mary Kathleen in Queensland is just starting; several other areas of South Australia and the Northern Territory give evidence of worthwhile deposits of uranium ore. In general, the ores are being treated by sulfuric acid digestion in rubber-lined tanks, using a batch process in which the ground ore is treated with a mixture of sulfuric acid and pyrolusite at a pH of 1.1. The uranium is finally precipitated as the hydroxide by addition of a magnesia slurry.

In Victoria, brown coal is mined, dried, and briquetted as raw material for a Lurgi high-pressure gasification plant. At an operating pressure of 500 lb./sq. in., 160 cu. ft. of oxygen and 80 lb. of steam are consumed per 1,000 cu. ft. of purified gas. The gas contains 20% methane, and has a heating value of 465 B.t.u./cu. ft.; it is conveyed to Melbourne, a distance of over 100 miles. As the demand for gas is seasonal, the plant capacity in summer greatly exceeds requirements; use is to be made of this excess capacity by the installation of a Fischer-Tropsch plant capable of producing 12 million gallons per year of gasoline, and 14 million gallons of light and fuel oils.

At Silverwater, New South Wales, it is planned to provide approximately 150,000 tons of furnace oil annually for cracking to high-B.t.u. gas and aromatics. The gas will be piped to the Australian Gas Light Company in Mortlake; aromatics, ethylene, and other hydrocarbons will be recovered from the cracked gas for use as raw materials in chemical manufacturing.

From Chemical Engineering in Australia, J. P. Baxter.

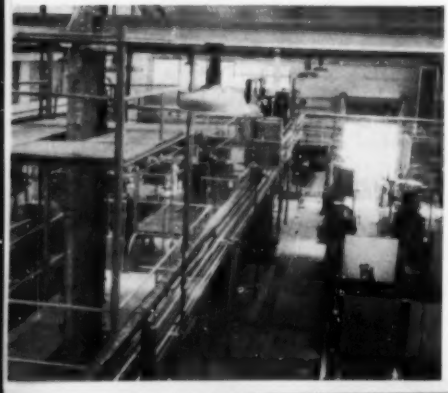
MEXICO

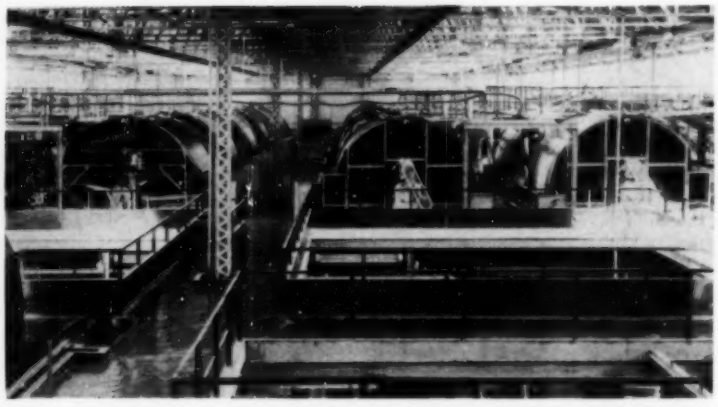
A spiral solar evaporator, twelve miles long, is a typical example of Mexican ingenuity in the application of chemical engineering principles to local needs and conditions. Lake Texcoco, near Mexico City, is a rich source of sodium and potassium salts in solution. For the economic exploitation of these resources, Mexican chemical engineers came up with the design of a solar evaporator called a "caracol," or snail, because of its spiral form. The "caracol" is a canal about twelve miles long, bounded by concrete walls and consists essentially of a series of ponds connected by subterranean inlets and outlets. The outer edge of the evaporator is about eight inches higher than the center of the spiral; brine entering from the lake takes about a year to reach the center. During the passage of the brine through the snail, concentration of the liquor is increased from 22 grams per liter to 200 grams per liter. From the center of the spiral, the concentrated brine is pumped to crystallizers where the separation and refining process starts.

Another typical Mexican development has been the efficient use of bagasse as a raw material for pulp and paper manufacture. The process involved permits use not only of bagasse, but also of other agricultural products such as straw. It is claimed that the resulting pulp has properties comparable to wood pulp and that certain grades of paper (tissue paper, for example), have been made for the first time from sugar cane wastes. The plant and equipment which made this development possible was wholly designed and built in Mexico.

From Development and Present Status of Chemical Engineering in Mexico, C. Duhne, X. A. Dominguez, and J. Santisteban.

Unit operation laboratory, Monterrey Technological Institute.





Acid-proof rotary filters in a uranium plant.

SOUTH AFRICA

The showpiece of South African chemical engineering is the largest oil-from-coal project in the world—the giant $230 million venture of the South African Coal, Oil and Gas Corp. (SASOL). Situated on top of a low-grade bituminous coal deposit estimated to contain over 300 million tons, the plant will produce 55 million Imperial gallons of gasoline per year, plus by-products which will form the basis for an expanding chemical and petrochemical industry.

The process used at SASOL is centered around two variants of the Fischer-Tropsch process. One variant (Arge process) is based on the experience of Arbeit-Gemeinshaft Lurgi and Ruhrchemie of Germany; this is a fixed-bed process. The other (Kellogg process) utilizes a moving bed. Raw materials are coal and oxygen, the latter produced in one of the largest Linde oxygen plants in the world, with a capacity of 2,000 tons per day of 99% oxygen.

Of capital importance to the economy of South Africa, and to the whole Western World, is the recovery of uranium from South African gold mine concentrates. The most serious problem posed was the separation and purification of soluble uranium compounds from the leach liquors; this was solved by application of a typically chemical engineering technique—ion exchange. Involved in the solution of this problem were the Government Metallurgical Laboratory in South Africa, the Chemical Research Laboratory of the D.S.I.R. in England, M. I.T., Battelle Memorial Institute, and Dow Chemical in the U. S.

One of the main problems of the chemical, and other, industries in South Africa is the general scarcity of water. Retreatment of sewage effluent is widely practiced. At Pretoria, for example, 100% usage is made of effluent, while two power stations at Johannesburg use 3 and 5 million gallons per day, respectively. The total treated sewage effluent from one of the industrial towns near Johannesburg is, after additional chlorination, used at a pulp plant at Enstra.

Notable advances have been made in South Africa in the practical application of electrodialysis for the demineralization of water on a large commercial scale. A plant under construction in the Orange Free State will treat 3 million gallons of mine water per day; the desalted water will be used for ore processing, uranium recovery, and domestic use, will replace fresh water now pumped from a river forty miles away.

From Chemical Engineering in the Union of South Africa, O. B. Volckman.

Uranium plant in the Orange Free State.

Philadelphia Transportation Co.

Market Street

1908

PHILADELPHIA

1958

Jubilee Town, June 22-27

The wheel has come full circle—it is fitting that the Golden Jubilee Meeting of the A.I.Ch.E. should be celebrated in Philadelphia where the society was born fifty years ago. Gathered there for the historic occasion will be the aristocracy of American Chemical Engineering, past and present, as well as a galaxy of distinguished foreign scientists and engineers come to present the greetings of their societies and to cement further the increasingly strong international bonds which link the chemical engineering fraternity all over the world.

The fruits of a half century of dedicated work by thousands of chemical engineers, some of them completely unsung, is strikingly symbolized by the contrast between the first meeting of the founders in 1908, attended by some forty men, and the coming Jubilee Meeting, where attendance may well reach two thousand.

A Look to the Future—this is the forward-looking theme of the Jubilee Meeting. The Past, however, must not be disregarded—without it, there would be no Present and, more important, no Future. In the preceding pages of this issue of CEP, an attempt has been made to illustrate graphically the enormous strides made in America in chemical engineering—in theoretical work, in the development of practical and economic processes, and in the invention and perfection of the right equipment to do the job.

Honor will be paid in Philadelphia to three men – Jerome Alexander, Frederick Dannerth, David Wilbur Horn – who were present at the founding of the A.I.Ch.E., and who have lived to witness its development into one of the major American engineering societies. The Awards Session (Monday, June 23) will see the presentation of Honor Medallions to past officers and directors of the Institute, and the inauguration of the newest honor of the A.I.Ch.E., the Founders Award, which will be received by five men chosen for their contributions to the profession of chemical engineering.

Pomp and academic robes will be the order of the day on Wednesday at the Ceremonial Session to be held in the Irvine Auditorium of the University of Pennsylvania. Both foreign and American delegates will present the greetings of their societies to George E. Holbrook, President of A.I.Ch.E.

At no recent National Meeting of A.I.Ch.E. have members had the opportunity to hear and to meet such a distinguished group of speakers. From England comes John A. Oriel, Past President of the Institution of Chemical Engineers, London, to speak on "Science in History" (Wednesday, luncheon). From our own shores comes Crawford H. Greenewalt, President of E. I. du Pont de Nemours, to talk at the Golden Jubilee Banquet (Wednesday, evening). The keynote of the whole meeting will be sounded by M. E. Spaght, Shell Oil, on Monday (Keynote Session, C. C. Furnas presiding); "Minutes of the Last Meeting" is his subject. Lee DuBridge, president of California Institute of Technology, is the guest speaker at the Awards Session (Monday, evening) on "Quality Must Come First." At luncheon on

continued on page 110

Philadelphia City Planning Comm.

Penn Center, looking west

SUNDAY, JUNE 22

2:30 P.M. to 4:30 P.M.

PANEL DISCUSSION—WHERE ARE ENGINEERS' SALARIES HEADED? R. A. Kinckiner, Du Pont, moderator.

How Do Engineers' Salaries Relate to U. S. Economy? W. W. Kraft, Lummus Co.

How Do Salaries of Chemical Engineers Compare to Those of Other Engineers? E. B. Peck, Rutgers Univ.

What Factors in the Market for Engineers Affect Their Salaries? J. C. De Haven, Rand Corp.

Do Engineers Receive Other Compensation? W. T. Nichols, Arthur D. Little Co.

8:30 P.M. to 10:30 P.M.

• **GOLDEN JUBILEE PARTY**

MONDAY, JUNE 23

10:00 A.M. to 11:30 A.M.

• **KEYNOTE SESSION,** C. C. Furnas, Univ. of Buffalo, presiding.

Keynote Address—"Minutes of the Last Meeting," M. E. Spaght, Shell Oil Co.

2:00 P.M. to 4:30 P.M.

SYMPOSIUM—THE SHAPE OF THE FUTURE IN RAW MATERIALS, ENERGY, HUMAN, AND CAPITAL RESOURCES. C. D. Wrigley, Atlantic Refining, presiding.

Raw Materials of the Future, R. Ewell, Univ. of Buffalo.

Energy of the Future, N. B. Guyol, Standard Oil of Calif.

Human Resources — A Vital Factor, J. Creese, Drexel Inst. of Tech.

Where is the Money Coming From? C. R. Whittlesey, Univ. of Penn.

SYMPOSIUM—CHEMICAL ENGINEERING IN THE NUCLEAR FIELD. R. P. Genereaux, Du Pont, presiding.

The Nuclear Field—An Engineering View, W. K. Woods and B. Weidenbaum, Vallecitos Atomic Lab.

Chemical Engineering Contributions to Progress in the Nuclear Field, J. R. Huffman and C. E. Stevenson, Phillips Petroleum.

Nuclear Effects on Chemical Engineering, J. J. Martin and H. A. Ohlgren, Univ. of Mich.

Opportunities for Nuclear Progress, W. K. Davis, AEC, and W. A. Rodger, Argonne Nat. Lab.

SYMPOSIUM — TRENDS IN MATERIALS OF CONSTRUCTION—NONMETALS (Part 1). R. B. Filbert, Jr., Battelle, presiding.

Plastics Construction in the Chemical Process Industries, W. C. Goggin and E. E. Ziegler, Dow Chemical.

Rubbers as Materials of Construction for the Chemical Process Industries, B. S. Garvey, Jr., Pennsalt Chemical.

Ceramic Materials for Corrosion Resistance in the Chemical Process Industries, W. A. Deringer, A. O. Smith Corp.

Ceramic Materials for High-Temperature Applications in the Chemical Process Industries, M. J. Snyder, Battelle.

8:00 P.M. to 9:30 P.M.

• **AWARDS SESSION.** G. E. Holbrook, president A.I.Ch.E., presiding

Presentation of Citations to charter members; Jerome Alexander, Frederick Dannerth, and David Wilbur Horn.

Presentation of Honor Medallion to past officers and directors.

Presentation of Founders Award to: T. H. Chilton, J. V. N. Dorr, O. A. Hougen, S. D. Kirkpatrick, and W. K. Lewis.

Speaker: Lee DuBridge, president, Calif. Inst. of Technology—"Quality Must Come First."

TUESDAY, JUNE 24

9:00 A.M. to 11:30 A.M.

SYMPOSIUM—NEW HORIZONS IN MANAGEMENT (Part 1). E. Wall, Du Pont, presiding.

The Need for Scientific Management, W. R. Collings, Dow-Corning.

The Analogy Between the Problems of Systems Engineering and Management, H. H. Goode, Univ. of Mich.

An Integrated Approach to Management Problems, N. J. Ream, Lockheed Aircraft.

New Management Tools—Information Systems, E. Wall, Du Pont.

SYMPOSIUM—THE CHANGING FIELD OF UNIT OPERATIONS—FLUID AND DIFFUSIONAL AREAS (Part 1). C. R. Wilke, Univ. of Calif., presiding.

Problems in the Application of Fluid Mechanics to Chemical Engineering, T. Baron, Shell Development.

Progress in the Fundamentals of Heat Transfer, M. T. Cichelli, Du Pont.

Future Trends in Heat Transfer Technology, D. Q. Kern, D. Q. Kern Assoc.

Mass, Heat, and Momentum Transfer Between Phases, T. K. Sherwood, MIT.

SYMPOSIUM — TRENDS IN FUNDAMENTALS OF CHEMICAL ENGINERING (Part 1). J. L. Franklin, Nat. Bur. of Standards, presiding.

Molecular Engineering, H. G. Drickamer, Univ. of Ill.

The Molecular Structure of Liquids, J. S. Dahler, Wright Air Development Center.

Non-Equilibrium Thermodynamics: A Survey, K. G. Denbigh, Univ. of Edinburgh, Scotland.

Some Aspects of Fluid Mechanics in Chemical Engineering, B. H. Sage, Calif. Inst. of Tech.

12:00 Noon

• **LUNCHEON, Speaker, A. B. Kinzel,** vice president-research, Union Carbide, "Research in Engineering."

2:00 P.M. to 4:30 P.M.

SYMPOSIUM—NEW HORIZONS IN MANAGEMENT (Part 2). E. Wall, Du Pont, presiding.

New Management Tools—Information Machines, M. Taube, Documentation, Inc.

New Management Tools—Computers, T. I. Peterson, IBM.

New Management Tools—Data Collection, I.D.P., and Feedback, S. N. Alexander, Nat. Bur. of Standards.

Management of the Future, E. D. Reeves, Esso Research and Eng.

SYMPOSIUM—THE CHANGING FIELD OF UNIT OPERATIONS—FLUID AND DIFFUSIONAL AREAS (Part 2). C. R. Wilke, Univ. of Calif., presiding.

Diffusion Combined with Chemical Kinetics, R. L. Pigford, Univ. of Del.

Progress in Fractional Distillation, R. L. Geddes, Stone and Webster.

Liquid-Liquid Extraction—Past, Present, and Future, R. B. Beckman, Carnegie Inst. of Tech.

Progress in Adsorption, Ion Exchange, and Membrane Separation, G. P. Monet, Du Pont, and T. Vermeulen, Univ. of Calif.

SYMPOSIUM — TRENDS IN FUNDAMENTALS OF CHEMICAL ENGINEERING (Part 2). J. L. Franklin, Nat. Bur. of Standards, presiding.

Rate Constants and Molecular Structure, H. S. Johnston and K. S. Pitzer, Univ. of Calif.

Contact Catalysis as a Unit Process, M. Boudart, Princeton Univ.

Experimental Foundations of Chemical Engineering, R. R. White and S. W. Churchill, Univ. of Mich.

The Relationship Between Fundamental Physics and the Chemical Engineering of the Future, J. O. Hirschfelder, Univ. of Wis.

8:45 P.M.

• **DELAWARE MOONLIGHT CRUISE AND SMORGASBORD.**

Program Sessions in Philadelphia

WEDNESDAY, JUNE 25

9:30 A.M. to 11:00 A.M.
• CEREMONIAL SESSION

Presentation of Greetings from Other Engineering Societies to A.I.Ch.E.

Paul D. Foote, Assistant Secretary of Defense, speaker. Subject to be announced.

12:00 Noon
• LUNCHEON, John A. Oriel, C.B.E., M. C., M. A., B. Sc., F. R. I. C., past president, Institution of Chemical Engineers, London, Eng., "Science in History."

2:00 P.M. to 4:30 P.M.
SYMPOSIUM—TRENDS IN MATERIALS OF CONSTRUCTION—METALS (Part 2). E. M. Mahla, Du Pont, presiding.

Corrosion Mechanisms and Materials Selection Methods, F. LaQue, Int. Nickel.

Stainless Alloys—Present and Future, W. O. Binder, Electro Metallurgical Co.

Titanium and Zirconium in Chemical Plant Applications, L. J. Barron, Du Pont.

Metals of the Future, H. R. Ogden, Battelle.

SYMPOSIUM—WHERE ARE WE GOING IN CHEMICAL ENGINEERING EDUCATION—ACADEMIC (Part 1). F. M. Tiller, Univ. of Houston, presiding.

Evolution of the Unit Operations, W. K. Lewis, MIT.

Development of Chemical Engineering, D. L. Katz, Univ. of Mich.

Present Status of Unit Operations, W. Licht, Univ. of Cincinnati.

Statistical Analysis of Accredited Chemical Engineering Curricula, A. X. Schmidt, City College of N. Y.

SYMPOSIUM—THE CHANGING FIELD OF UNIT OPERATIONS—SOLIDS AREA (Part 1). N. Morash, Nat. Lead Co., presiding.

Gas-Solids Separation (Dry Methods), S. K. Friedlander, Johns Hopkins Univ.

The Art and Science of Liquid Filtration, H. P. Grace, Du Pont.

Separation by Crystallization, R. A. Findlay and D. W. McKay, Phillips Petroleum.

6:00 P.M. to 7:30 P.M.
• DUTCH TREAT COCKTAILS

7:30 P.M. to 10:00 P.M.
• GOLDEN JUBILEE BANQUET, Speaker, Crawford H. Greenewalt, president, Du Pont.

10:00 P.M. to 1:00 A.M.
• GOLDEN JUBILEE BALL.

THURSDAY, JUNE 26

9:00 A.M. to 11:30 A.M.
SYMPOSIUM—THE CHANGING FIELD OF UNIT OPERATIONS—SOLIDS AREA (Part 2). E. E. Ludwig, Dow Chemical, presiding.

Mixing of Fluids, J. H. Rushton, Purdue Univ., and J. Y. Oldshue, Mixing Equipment Co.

Mixing of Solids, S. S. Weidenbaum, Corning Glass.

Size Reduction, L. T. Work, consultant.

Drying—Its Status in Chemical Engineering, W. R. Marshall, Jr., Univ. of Wis.

SYMPOSIUM—WHERE ARE WE GOING IN CHEMICAL ENGINEERING EDUCATION—ACADEMIC (Part 2). F. M. Tiller, Univ. of Houston, presiding.

Some Implications Concerning Chemical Engineering Education, H. B. Kendall and S. Calvert, Case Institute.

The Engineering Science Approach in Teaching Chemical Engineering, W. H. Corcoran, Calif. Inst. of Tech.

Professional Education in Chemical Engineering, R. R. White, Univ. of Mich.

Graduate Work in Chemical Engineering, K. A. Kobe, Univ. of Texas, and A. B. Metzner, Univ. of Del.

SYMPOSIUM — MOVING FORWARD IN PROCESS CONTROL (Part 1). D. B. Boyd, Jr., Universal Oil Products, presiding.

Process Control—A Major Factor in Chemical Engineering of the Future, J. B. Roberts, Du Pont.

History of Automatic Control in the Chemical Process Industries, D. J. Bergman, Universal Oil Products.

The Concepts of Process Dynamics, E. F. Johnson, Princeton Univ.

Chemical Reaction System Dynamics, A. S. Foss, Du Pont.

12:00 Noon
• LUNCHEON, speaker to be announced.

2:00 P.M. to 4:30 P.M.

SYMPOSIUM—WHERE ARE WE GOING IN CHEMICAL ENGINEERING EDUCATION—INDUSTRIAL W. J. Borns, Socony-Mobil Oil, presiding.

A Technical Study Course Sponsored by an Institute Section, W. R. Manning, R. E. Pyle, and A. G. Gibson, Union Carbide.

A Curriculum Organized by an Industry and a University, D. H. Morgan, Dow Chemical.

An Advanced Program of a Specialized Industry, J. J. Merrill and H. M. Lavender, California Research.

An Industry Sponsored Program with Liberal and Business Courses in Addition to Technical, C. H. Elliott, Socony Mobil Oil.

SYMPOSIUM—WHAT IS AHEAD IN KINETICS AND REACTIONS (Part 1). O. Hougen, Univ. of Wis., presiding.

Reaction Rates in Chemical Engineering Science, H. M. Hulburt, American Cyanamid.

Transport Processes with Chemical Reactions, S. Prager, Univ. of Minn.

Turbulent Transport in Chemical Reactors, J. Beek, Jr. and R. S. Miller, Shell Development.

Intraparticle Diffusion in Porous Catalysts, P. B. Weisz, Socony Mobil Oil.

SYMPOSIUM — MOVING FORWARD IN PROCESS CONTROL (Part 2). P. S. Buckley, Du Pont, presiding.

Measurement Aspects of Process Control, A. R. Aikman, Schlumberger Well Surveying.

Organization for Process Control, T. J. Williams and J. O. Hougen, Monsanto.

Developments and Trends in Process Control in Europe, A. J. Young, I.C.I.

What is Ahead in Process Control, W. E. Vannah, McGraw-Hill.

FRIDAY, JUNE 27

9:00 A.M. to 11:30 A.M.
SYMPOSIUM—CHEMICAL ENGINEERING AND MISSILES. B. M. Landis, General Electric, presiding.

The Challenge of the Space Age, R. B. Filbert, Jr., Battelle.

New Chemical Fuels—An Engineering Challenge, W. R. Millard, Callery Chemical.

Chemical Engineering and the Solid Propellant Industry, E. S. Stern, Thiokol Chemical.

New Chemical Engineering Opportunities in Solid Propellant Applications, R. A. Cooley, Propellex Chemical Corp.

SYMPOSIUM—WHAT IS AHEAD IN KINETICS AND REACTIONS (Part 2). A. Syverson, Ohio State Univ., presiding.

Contacting in Packed Bed Reactors, R. H. Wilhelm, Princeton Univ.

Mass and Heat Transfer in Heterogeneous Gas Reactions, E. Wicke, Univ. of Hamburg, Germany.

Turbulent Flames Stabilized in High Speed Flow, M. Summerfield, Princeton Univ.

Stability of Chemical Reactors, C. H. Barkelew, Shell Development.

SYMPOSIUM—ECONOMIC EVALUATION—KEY TO ENGINEERING DECISIONS. J. B. Weaver, Atlas Powder, presiding.

Economic Evaluation—Ascent from the Past, C. Tyler, Du Pont.

Economic Evaluation—Organization and Coordination, C. A. Stokes, Texas Butadiene and Chemical.

Economic Evaluation—Inklings of the Future, E. C. Dybdal, Monsanto.

Economic Evaluation—Crying Needs, C. H. Chilton, McGraw-Hill.

2:00 P.M. to 4:30 P.M.

SPECIAL SESSION—THE USE OF MOTION PICTURES IN CHEMICAL ENGINEERING TECHNOLOGY. E. F. von Wettberg, Jr., Du Pont, presiding.

Jubilee Town, June 22-27

from page 107

Tuesday, Augustus B. Kinzel, Union Carbide, will speak on "Research in Engineering."

Today's students, building blocks for the future, have not been neglected by the planners of the Jubilee Meeting. A special Luncheon, a Student Award Dinner, a Student Social, and a special afternoon Conclave have been arranged for what is sure to be the largest student attendance ever recorded at an A.I.Ch.E. National Meeting to the present time.

Plant trips, twelve in number, will be a highlight of the Meeting. Several of them, including an Historical Tour of Philadelphia and a visit to the Campbell Soup Co. plant, will be of interest also to the ladies who, in addition, will be the guests of the A.I. Ch.E. at a whole series of social functions; the chief drawing card will doubtless be the Delaware Moonlight Cruise and Smorgasbord on Tuesday evening.

Once in a lifetime comes such an opportunity. Make your plans now!

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Technical Program—The Shape of the Future

The shape of the future in raw materials, energy, human and capital resources in the session C. D. Wrigley will head to lead off. Forecasts of the future are a common part of our personal and business lives. But the farther in the future the projections extend, the more difficult the job of forecasting with any reasonable degree of accuracy becomes. Nevertheless, forecasts of the longer range future will be the order of the day in Wrigley's session, and the tone will be one of challenge—of trying to recognize the signs that illuminate the years ahead so that we can act accordingly.

Raw materials of the future will be explored by Ewell. Judging by past performance, the rate of consumption of raw materials can be expected to accelerate, so that it will become necessary to use lower and lower grade sources. As the use of poorer sources becomes more widespread, better technology must be applied by the chemical engineer. **Energy of the future** comes in for study by Guyol, who points out that although the world's reserves of conventional sources of energy are still abundant, the energy requirements are increasing while unit energy costs are rising. The combined effect of these two is imposing a strain on the economies of many countries, especially those which must import part of their energy supplies. New sources of energy, analyzed by Guyol, may be a solution to their problem.

Human resources are, perhaps, the most vital factor, according to Creese. As the world's population multiplies, and its natural resources diminish, we shall have to rely more on the ingenuity of our creative scientists. Increasingly greater numbers in our society must be given every opportunity to receive the highest level of education available. As pertinent as the question of human resources, is the question of Whittlesey—**Where is the money coming from?** The allocation, regulation, and safeguarding of financial resources may require less attention than in the past, partly because we have past accomplishments along these lines to build upon. More attention will be directed in the future towards assuring that the rate of flow of investable funds is in accordance with such goals as stable prices, high level of employment, and economic growth.

Chemical engineering in the nuclear field

The discovery and proof of nuclear fission gave birth to the release of huge quantities of energy with untold potential. This symposium, under R. P. Genereaux, will show that to accomplish this, the wealth of existing technology was applied successfully only because many new techniques and materials were created to meet the complex new requirements and hazards of critical mass and radioactivity. Chemical engineers can well afford to take a broad look at the intense world-wide interest in nuclear energy since the rate of growth of nuclear power depends on the rate of reduction of its cost through improved technology to enable it to compete with the limited supply and rising cost of fossil fuels.

An engineering view of the nuclear field, say Woods and Weidenbaum, will afford the chemical engineer an orientation in the nuclear field as it has evolved. The broad scope of the field will be outlined, and the status of engineering development in the field summarized. The nature and role of chemical reprocessing will come in for special attention. **Chemical engineering contributions to progress in the nuclear field** are detailed by Huffman and Stevenson. Since 1941, chemical engineers have played a prominent role in the development of nuclear energy, both for military and peaceful uses. As early as 1945, members of the Institute explored the possible impact of the nuclear field on chemical engineering, and this is the time to evaluate and plan ahead. Conversely, it is also time to consider **nuclear effects on chemical engineering.** Martin and Ohlgren do just that, and will show that the impact of nuclear energy has been particularly strong on the chemical engineering profession and its educational programs. Several thousand chemical engineers are now employed in the nuclear field; many of them have had to spend much time augmenting their basic education to include the nuclear technology; many more will probably soon be considering the step. Lastly, Davis and Rodger will ask and help answer the big question of what are the **opportunities for nuclear progress.** The challenge for the chemical engineer in this field is large. Much remains to be done before a full arsenal of economic processes for all types of fuels is available, and much work awaits the chemical engineer in the isotope field. Answers must be found for the problems of waste storage and equipment decontamination. It is expected that chemical engineers will also become more involved in the whole field of reactors.

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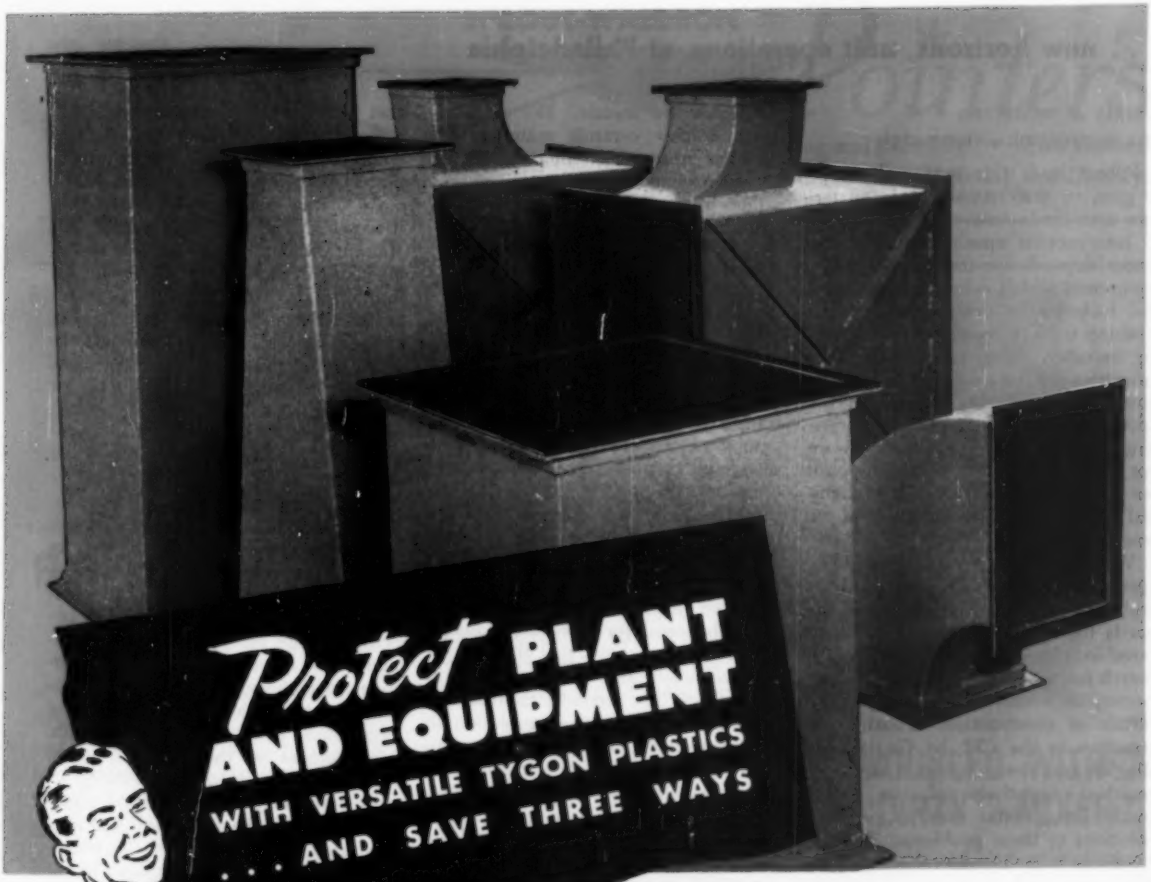

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Trends in materials of construction—nonmetals

Filbert leads this session designed to give an understanding of the nature and limitations of the materials of construction upon which the engineer depends for the buildings and equipment which comprise the plants and factories he designs and builds. Nothing is more basic to any processing industry. Progress in the process industries can, in a sense, be measured directly in terms of progress in the development of the materials of construction which they use. If it were not for the materials at our disposal, we would not have many of the chemical processes which we accept so freely.

Wars, national emergencies, shortages of raw materials, unavailability and high cost of skilled labor, and the needs for stretching capital as far as possible, have all accelerated the search for substitute materials, and for better, more useful, and cheaper materials of construction. **Plastic construction in the CPI,** by Goggin and Ziegler considers one such new material—the synthetic plastics, tailormade for specific uses as potential solutions to these problems. Thought by many to be closely related to plastics, yet unique in its own right, rubber is little affected by, and has little effect on, many materials used in the chemical process industries. Types and characteristics of various synthetic rubbers will be given by Garvey in **rubbers as materials of construction for the CPI.** Some of the present and future demands on rubbers, such as resistance to rocket fuels, radiation, and both higher and lower temperatures, will be cited.

Ceramic materials for corrosion resistance in the C.P.I. by Deringer will consider the properties of (1) glass coatings for steel, (2) solid glass, (3) chemical porcelain, and (4) graphite compositions. A number of products made from these materials for chemical service will be analyzed, and some indication of their future in the chemical process industries will be given. Turning to **ceramic materials for high temperature applications in the C.P.I.,** M. Snyder, points out that ceramic materials such as ordinary fireclay, silica or chrome-magnesite brick; silicon carbide, fused alumina, graphite and carbon, and refractory concretes are used as construction materials in high temperature chemical processes when the temperatures are too high or the corrosive conditions too severe for metals. The development of new ceramic materials for chemical processing will probably be by improvement of existing materials rather than production of new compounds.

New horizons in management

This symposium, chaired by E. Wall, will give the reasons for improving management techniques in areas of planning, communications, administration and control. The similarities among physical systems, military systems, and corporate management systems are striking. It will be shown that the same principles of systems engineering are applicable to all three. Some answers will be given concerning the requirements of a good management system.

In the need for scientific management, Collings shows that the first industrial revolution was a revolution in technology. The second industrial revolution may well be a revolution in management techniques. Management must solve the problems arising from the rapidly increasing size of organizations, complexity of technology and difficulty in communications. In **the analogy between systems engineering and management,** Goode attempts to investigate the problems of management by considering the problems of systems engineering, assuming that if the problems are similar, then the solutions will also be similar. After suitable modification, solutions to problems in systems design may be applicable to problems of management by analogy.

An Integrated Approach to Management Problems, Ream, explains that the increase in complexity and scope of the problems of management has made it progressively more difficult to maintain satisfactory control of operations. Here is Lockheed's integrated approach to management systems engineering. A review of present integrated system in operation in the manufacturing control area will be presented, together with a discussion of anticipated benefits. **New management tools—information systems,** is Wall's subject. Because many of the problems facing management are concerned with effective communications, several facets of the communications problem and their solutions have to be explained. Information systems—why needed, objectives, and essential characteristics will be outlined. Means of mechanizing the handling of information will also be considered. **New management tools—information machinery,** Taube, gives data information systems ranging from simple card files to the most complicated data processing systems; shows they are alike in principle, differing only in the efficiency of storing and retrieving information by matching interrogation against the store. **New management tools—computers,** by Peterson, outlines several applications of automatic data processing equipment in simulations and management control, and discusses their importance in management. **New management tools—data collection, IDP, and feedback,** Alexander. The flow of paper work associated with the growth of an industrial enterprise has grown in step in the past several decades. Resources needed to control this flow for processing it into operating records has become a large enough problem to demand the attention of top management. Significant aspects of the problem of automation in paper work, and production of goods, is dealt with. **Management of the future,** Reeves, shows that industrial technology is now embarking on the second phase of its growth. Past research has concentrated on development of individual processes, while emphasis in the future will be placed on the integration of all operations, to meet overall objectives with maximum effectiveness. This will require the development of new operating techniques.

The changing field of unit operations—fluids and diffusional area

It is natural that the mechanics of real fluids is one of the most important subjects of fundamental interest to chemical engineers, in view of the extensive handling of liquids and gases in the chemical process industries. Molecular transport phenomena are understood well enough for engineering considerations, but problem areas remain in liquid-phase diffusion, non-Newtonian flow, and turbulence and flow in complex geometries. This symposium, under C. R. Wilke, will consider current practice and problems for future solution.

Problems in the application of fluid mechanics to chemical engineering, Baron, reviews the status of fluid mechanics in chemical engineering operations, and suggests that the study of flow instabilities offers a

continued on page 114

SPROUT-WALDRON

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"The flour flows like water" is the most common expression you'll hear around this plant. Although our engineering division tells us that true fluidization in any pneumatic system is only possible for short distances, when you see flour being unloaded and binned at the rate of 1000 lbs/minute, you feel like saying that if this flour isn't flowing like water, it sure is mighty close! Reprints of the article describing the system at Wonder Bread are available on request. Our files contain many case history articles, catalog and technical reports. For prompt analysis of your materials handling problem, contact your Sprout-Waldron representative.

LABORATORY PELLET MILL USED IN RESEARCH

The Sprout-Waldron Laboratory Pellet Mill exactly reproduces the end results to be anticipated from high production pelleting machines. This enables researchers to complete studies on many applications involving pelleting and to project operating methods and costs.

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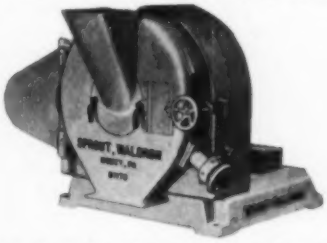
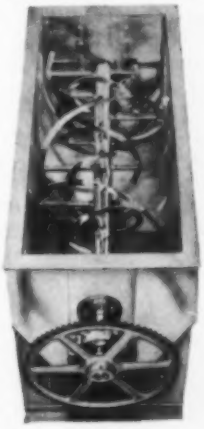


— SW —

THE BIG PLUS

Copies of the S-W condensed catalog (Bulletin No. 178) of equipment and systems for the chemical and processing industries are still available. This two color, 20 page booklet illustrates attrition, hammer, roller and pellet mills; vertical, horizontal and continuous mixers; sifters, crushers, blenders, bucket elevators, conveyors, feeders and the complete line of pneumatic handling equipment, bulk trucks and storage structures.



TROUBLED WITH A "DIRTY" MIXER?

Pigment and dye manufacturers know the danger of color contamination. That's why so many of them specify the Sprout-Waldron mixer with its smooth crevice-free stainless steel interior.

Take a good look at the unretouched interior above. Notice the smooth surface, the large radius welds, the absence of bolts and the many signs of Sprout-Waldron craftsmanship which assure you of a mixer that is easy to clean, and designed to produce perfect batches day in and day out.

This small Laboratory Mixer is suitable for production work. Its features include: variable speed drive, stainless steel construction throughout, jacket for heating or cooling, thermometer well and flush type, liquid-tight plug gate. From the smallest Lab Mixer to the largest conceivable production model, you can rely on Sprout-Waldron know-how to keep your products free from contamination. Ask for Bulletins 194, 128 and 148.

CP/103

fruitful area for future research. **Progress in the fundamentals of heat transfer,** Chichelli. Progress in heat transfer science in the past 50 years is briefly reviewed. Emphasis is placed on those developments having the greatest impact on chemical engineering practice. **Future trends in heat transfer technology,** Kern, shows that new technologies in the fields of missiles, satellites, nuclear reactors, and high temperature processes are expected to outmode present concepts in heat transfer. Future heat transfer developments will be derived from extensions of current chemical engineering techniques. **Mass heat, and momentum transfer between phases,** Sherwood, shows that analogies between heat, mass and momentum transfer processes have proven so basic to chemical engineering that it is possible to speculate on the possible development of a single theory to describe the three.

Diffusion combined with chemical kinetics. Pigford shows that a variety of industrial processes involve mass exchange between phases simultaneously with chemical reactions. Theoretical studies have led to methods of interpreting these phenomena. Available experimental data and results of theoretical analysis are reviewed. **Progress in fractional distillation,** Geddes, gives present status of fractional distillation knowledge from the chemical engineer's view, emphasizing problems in the design of modern fractionating columns. Gaps in present knowledge are pointed out and recommendations for further research indicated.

Liquid-liquid extraction—past, present, and future. It is expected, according to Beckman, that as more insight is gained concerning the factors affecting mass transfer from drops, and their hydrodynamical behavior, the number of different types of extractors will be merged into a relatively few. **Progress in adsorption, ion exchange, and membrane separation,** Monet. The current status of adsorption, ion exchange, dialysis, and membrane processes as separation methods is reviewed; paying particular attention to their similarities with respect to equilibria, kinetics, process arrangement, and design techniques. #

Trends in fundamentals of chemical engineering

Franklin's symposium deals with the future fundamentals of chemical engineering, and emphasizes new subject matter which will become part of the knowledge of chemical engineering in the future. The engineer must anticipate changes and developments in the discipline as it is already understood. Therefore many aspects of the fundamentals already accepted as basic have been excluded, and only those aspects have been included which it is believed will become a part of the chemical engineer's tools in the next few generations.

Molecular engineering, Drickamer, reviews development of chemical engineering theory from the early empirical approach to the present, where it is possible to predict bulk properties of matter from molecular properties. The concept of molecular engineering is introduced. Future developments in such areas as transport phenomena in dilute gases, properties of dense gases and liquids, and especially of the fluid state are predicted. **The molecular structure of liquids,** Dahler, attempts to survey the present knowledge of the liquid state. The molecular structure of liquids in terms of various models will be discussed. An indication will be given of the direction that future development of liquid theory must take. **Non-equilibrium thermodynamics: a survey.** Denbigh's review covers the field of the "thermodynamics of irreversible processes." The three essential steps in the use of this form are the calculation of the entropy production, the setting up of the linear phenomenological equations, and the use of the Onsager reciprocal relation. The most important applications are to the transport processes and, especially, to the coupling phenomena which occur when two or more such processes take place in the same system. In **some aspects of fluid mechanics in chemical engineering,** Sage shows that in the first third of this century the chemical engineer was concerned with the application of macroscopic concepts to the prediction of momentum, energy, and material transport in fluid systems. Recently the need for a detailed molecular description of these phenomena has become apparent and has resulted in important advances in fluid mechanics. The value of fluid mechanics in thermal and material transport will be emphasized as applied to ordinary reaction systems and to ionized gases.

Rate constants and molecular structure, Johnston and Pitzer, discuss recent efforts to apply theorems of molecular structure and molecular spectroscopy to rate problems. This paper avoids the overwhelming complications of the theoretical approach and yet provides predictions, not just correlations, at the level of accuracy of experimental kinetics. **Contact catalysis as a unit process,** Boudart, shows that as more reactions are submitted to rigorous kinetic studies and their mechanisms become clearer, it is timely to attempt a regrouping of unit processes in broad kinetic classes. All gas phase reactions catalyzed at solid surfaces have a number of features in common. It is therefore convenient to consider contact catalysis as a unit process. **Experimental foundations of chemical engineering,** White and Churchill. Virtually all existing data in the rate processes have been forced into rationalizations based on either potential difference, or potential gradient models. While both models have been used effectively in the past, a strong plea is made for better differential rate data, and for more sophisticated concepts of rate phenomena. Present research appears to be directed primarily towards filling in the gaps in already available data and in refining the applications of the models. **The relationship between fundamental physics and the chemical engineering of the future,** Hirschfelder, distinguishes four categories of physical research: fundamental laws of physics; properties and behavior of molecules; macroscopic properties of materials; and experiments designed either to test or to apply a knowledge of physics. With the advent of sharper experimental tools on the one hand, and high speed computing devices and better mathematical methods on the other, one can predict that chemical engineering will continue to open up exciting new vistas.

Trends in materials of construction—metals

Led by A. M. Mahla, the discussion will focus on the operating plant of the future, on the use of expanding quantities of corrosion-resistant metallic materials in design, and on the development of new metals and alloys not now in common use as materials of construction in chemical processing plants.

Basic to all progress in the field of corrosion-resistant equipment is a knowledge of the fundamental mechanisms which cause corrosion, points out LaQue in a paper on **Corrosion**

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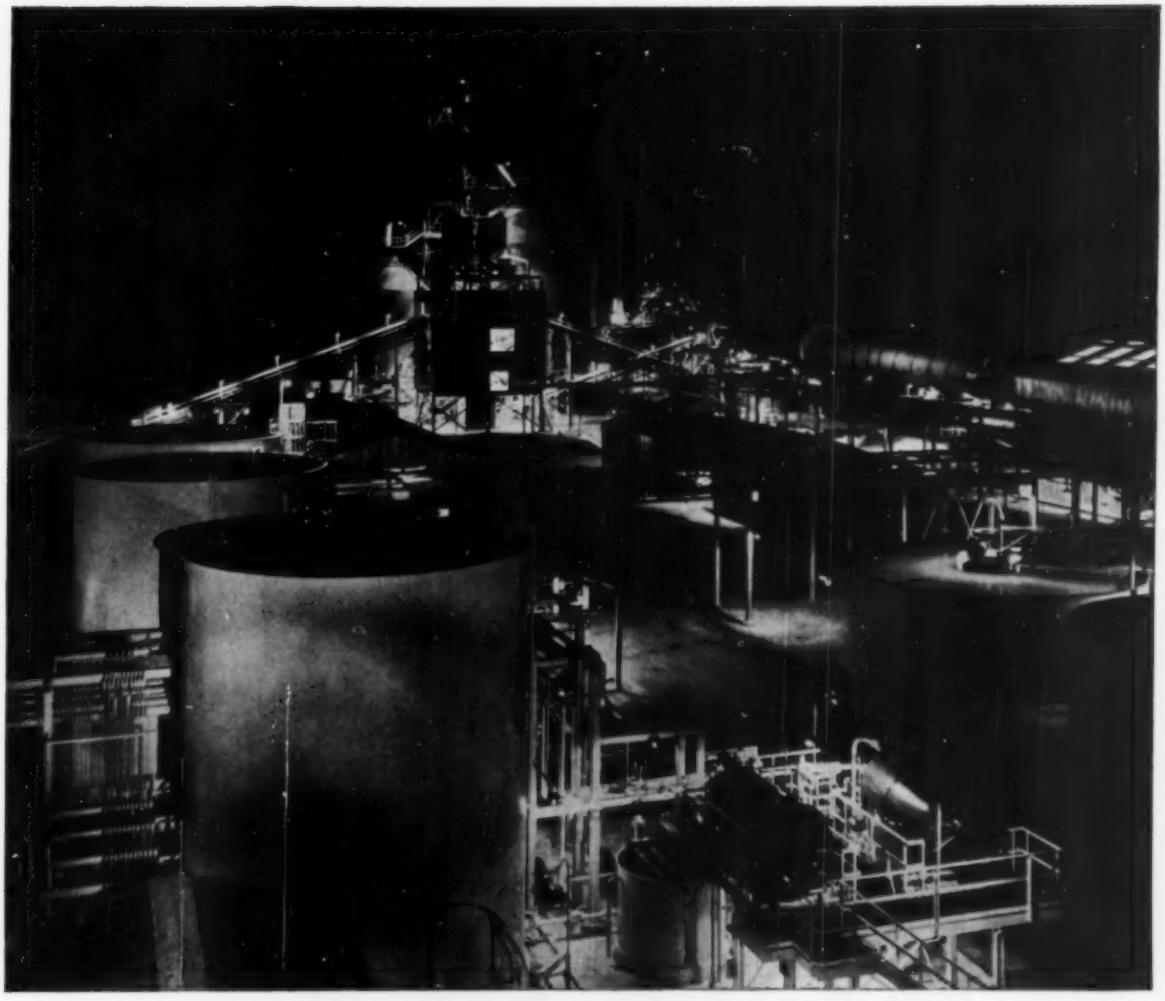

56 Tanks for First Large Plant to Produce Lithium Hydroxide from Lepidolite Ore

In fifteen short years, many uses have been found for lithium and its compounds—as a coolant for nuclear reactors, as an all-purpose lubricant, as a catalyst in polymerization, as a factor in making rocket fuel, to name a few.

Large quantities of lithium hydroxide are now assured by the construction of the first commerical plant for producing the compound from lepidolite ore. This new plant was designed and built by C. F. Braun and Co. for American Lithium Chemicals, Inc., at San Antonio, Texas, a subsidiary of American Potash & Chemical Corporation. All 56 tanks, of carbon steel, from the largest of 635,000 gallons to the smallest of 450 gallons, were fabricated and erected by Graver.

This installation is another example of Graver's capacity and century-long experience in fabricating the tankage requirements for complete plants. Similarly, Graver's nationwide facilities are frequently called upon to fabricate multiple-unit installations of processing equipment and pressure vessels for the chemical, petrochemical, petroleum and nuclear industries.

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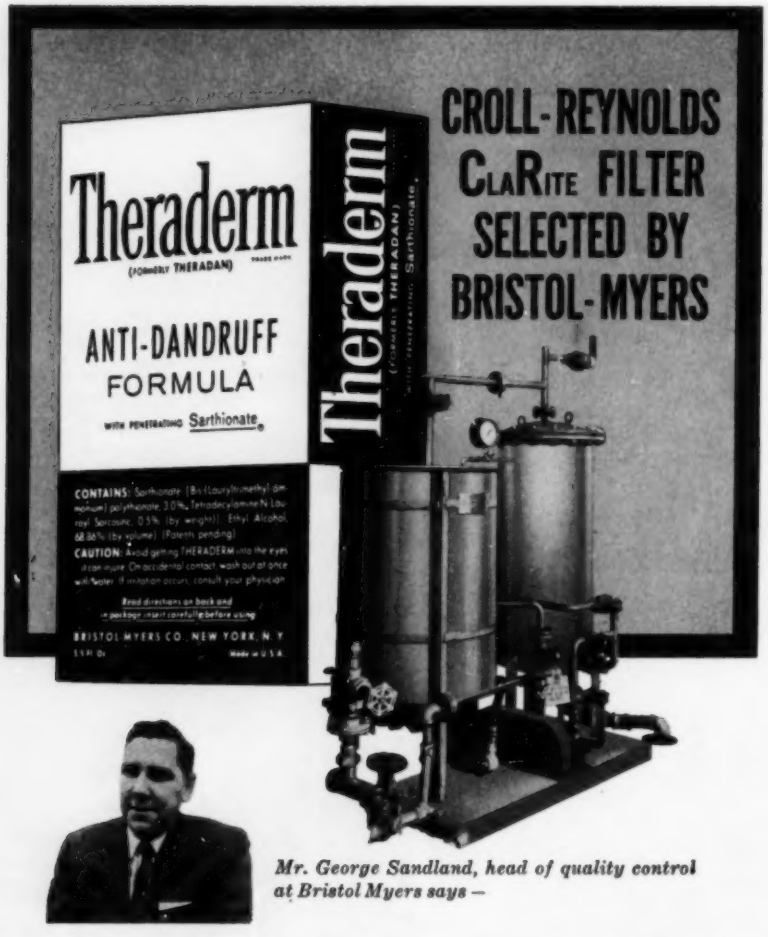

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Lapp

Acid process makes high-grade alumina from low-grade wastes and ores

New process, still in early pilot-plant stage, is another of Strategic Materials Corp.'s developments in recovering metals from low-grade ores. North American Coal Corp. is interested, will form a new company with Strategic to exploit the commercial possibilities of the process.

Key to the new Strategic-Udy process (it is another development of M.J. Udy and his son, M.C. Udy), appears to be the successful low-cost separation of the metallic sulfates, and the low-cost recovery of the recycle acid. In the past, the chief trouble with acid processes for alumina was relatively high cost and poor product quality compared to alkaline processes. Strategic claims that the new Udy process eliminates two high cost steps necessary in other acid processes, and produces a high purity alumina. While details are still a long way from being revealed, differential solubilities between the sulfates would appear to be a major part of the processing technique used.

The process

In general, the process, as it is being tested for North American Coal, starts with the reaction of mine waste material with sulfuric acid. This converts the aluminum and iron to soluble sulfates which can be leached and separated from the silica by filtration. Then the soluble sulfates are separated, the iron and aluminum sulfates decomposed, producing iron oxide and alumina. Sulfur dioxide and trioxide gases from the decomposition are recovered as sulfuric acid for recycle.

In contrast to the normal Bayer process, which uses high-grade imported bauxite, the Strategic-Udy process could use domestic low-grade ores with silica content as high as 15 percent. The importance of this to both future industrial needs, and national defense considerations is obvious.

Interesting variations in the process are possible. In an integrated system, for example, the company claims it could get its make-up acid from the high sulfur content of mine waste material. Also, the process is not limited to mine wastes, could be used with high-iron bauxite, of which there is a great deal, red mud waste, fly-ash, and some clays. Many of these are now being studied.

Mounds of waste

North American Coal's interest is obvious—it has great mounds of useless mine wastes. Plans are well underway to form Strategic North American Corp., a joint venture intended to eventually build and operate plants for the production of alumina and aluminum sulfate.

North American has three primary types of material on which it hopes to use the new process.

1) Current production of rejects from the coal cleaning plant in Cleveland. This is the company's major interest since the cost of trucking and dumping the material increases each year. Daily production of this waste is about 1500 tons, which could be increased easily.

2) So-called "red dog"—material already in waste piles which has undergone spontaneous combustion and is "burned out." This has the highest alumina content. The company estimates it has several millions of tons of this material.

3) Waste that has not "burned out" and is referred to as "gob." The alumina content of this is intermediate between the former two.

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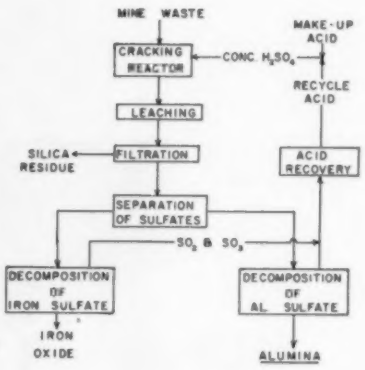

Alumina process: General flow sheet.

Cheaper, more abundant special metals

A new high-vacuum, electron-beam process may up the supply, lower the cost of such metals as titanium, zirconium, tantalum, molybdenum and columbium. May be commercially adaptable to any chemically-reactive, high-melting-point material.

Proven on a semiworks scale, the novel new process is the joint development of Stauffer Chemical, Mallory-Sharon Metals, and Temescal Metallurgical Corp. While somewhat cautious in actual commercial predictions at this time, the three companies are claiming a host of advantages and potentialities for the process.

The process uses electron bombardment in a high vacuum to melt chemically-active materials which have high melting points, makes possible volatilization and removal of certain critical impurities, and results, according to its owners, in final products of high purity with properties not attainable

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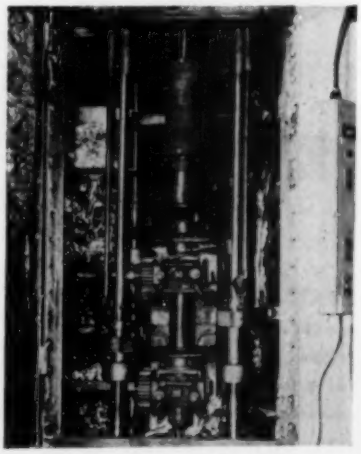

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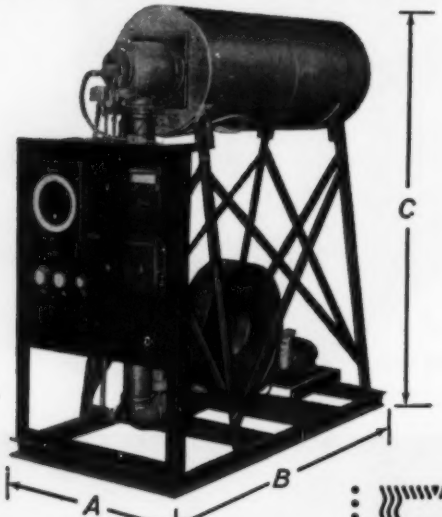
Type CA direct fired

Type CA air heaters are most frequently sold as "packaged" units complete with all necessary safety and control apparatus. These units will provide outputs ranging from 200,000 BTU/hr to better than 30,000,000 BTU/hr and at temperatures from 300F to 1500F or higher.

TYPICAL SIZES . . .

Listed below are the overall dimensions of a few of the dozens of output, temperature, and flow combinations possible in these heaters. Figures are for atmospheric pressure units. Higher pressure heaters would be smaller.

BTU/hr	AIR FLOW scfm	TEMP. IN °F	TEMP. OUT °F	A ft.	B ft.	C ft.
800,000	1,000	60	750 F	2½	4½	4
2,500,000	5,000	60	500 F	4	7	6
4,000,000	16,000	700	900 F	7	11	8
10,000,000	8,500	60	1,000 F	5½	10	8
15,000,000	10,000	60	1,200 F	6	12	8



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Udy-process

from page 118

A typical range of analysis of these wastes is: Al_2O_3, 16-25%; Fe_2O_3, 3-15%; SiO_2, 40-60%; sulfur, 5-12%; and carbon, 5-15%.

North American has the waste. The new process offers, in the company's view, the possibility of turning this useless material into commercial products of varying profitability. Alumina is the most important, followed by aluminum sulfate, iron oxide, silica, and low-ash powdered coal.

For Strategic-Udy, the advantage of adapting its process to mine waste materials lies in the close proximity of the present waste material to the aluminum reduction plants now moving into the Ohio valley which could make good use of low cost alumina.

Cheaper metals

from page 118

by other methods. The semiworks plant has successfully melted, purified, and cast a dozen special metals in water-cooled crucibles with no contamination from the crucible.

Chances are that electron beam melting will find most use in purification of refractory materials and such high-melting metals as: columbium, tantalum, molybdenum, beryllium, vanadium and special stainless steel alloys. Immediate significance of the process is claimed to be: stimulation in the development of the uses of these newer metals because the process will make available for the first time commercial quantities of high purity material at substantially lower costs; and the use of recycled scrap, thus reducing loss, an important factor, considering the relatively high cost of many of these materials.

The process

The process, conceived by Temescal, is based primarily on high vacuum techniques. Heat for melting is supplied by an electron gun which serves as the cathode and bombards the melt stock (the anode) with electrons, heating it to the melting point. Molten metal drops into a water-cooled copper crucible below, in which the heat required to maintain a molten pool is also provided by electron bombardment. The molten pool surface is kept at a constant level as the solidified ingot its withdrawn downward.

Electron beam melting may offer several important advantages over

continued on page 146

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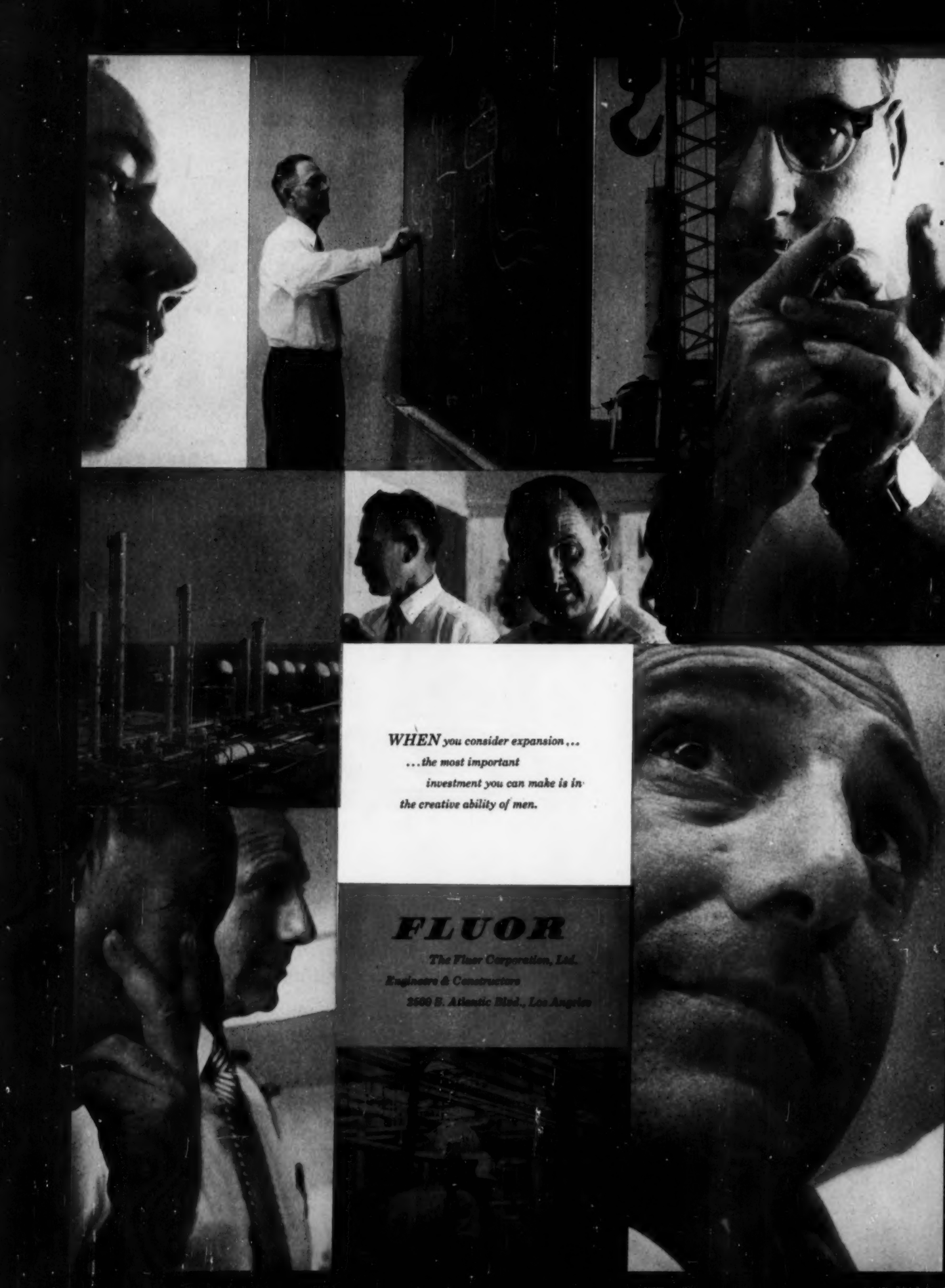

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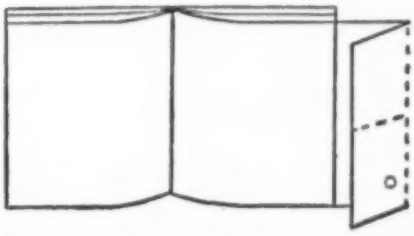

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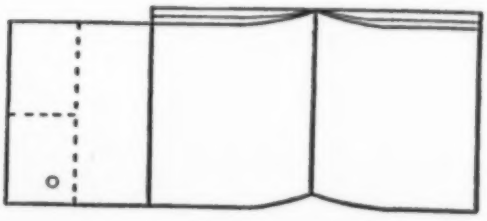

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EQUIPMENT

301 Turbine-Type Mixer Bulletin. Describes new design invented in Sweden, offered here by T. L. Smith Co.

302 Pulse Code Telemetering System. Positive displacement meter system has components compatible with systems now widely used for remote control work. Details from Vapor Recovery Systems Co.

303 Flow Pickups. Measure flow by determining fluid velocity in passage containing freely-spinning turbine wheel. Bulletin from Waugh Engineering Co.

304 SS Tubing and Pipe Data Card. Summarizes hot-working, annealing, welding, and forming data on 24 widely-used austenitic and ferritic stainless tubing steels. Babcock & Wilcox Co.

305 Electronic Control Bulletin. Describes the Levelitronic Relay, used for control of liquid level, pressure, and temperature. Instruments, Inc.

306 Propeller-Type Totalizing Flow Meter. Bulletin from Builders-Providence, Inc. gives diagrams, accuracy and pressure-loss graphs, data tables, charts.

307 Progressive Acid Regeneration System. Automatically increases acid regenerant concentration to cation units of demineralizers at prescribed rates in an infinite number of steps. Graver Water Conditioning Co.

308 Vibrator Catalog. Booklet from Syntron Co. gives complete data and specifications on 14 standard vibrators.

309 Voltage Monitor Case History. Describes unique application of the 2304-INT, product of Assembly Products Co.

310 Article on Continuous Digesters. Includes numbered flow sheet tracing material from incoming chip conveyor to pulp distribution to paper mill. Sprout, Waldron & Co.

311 Turbine Flowmeter Catalog. Gives single basic calibration curve for selection of proper turbine flowmeter, regardless of viscosity changes. Fischer & Porter Co.

312 High-Speed Mechanical Drive Turbines. Bulletin from General Electric describes application to the petroleum, chemical, and petrochemical industries.

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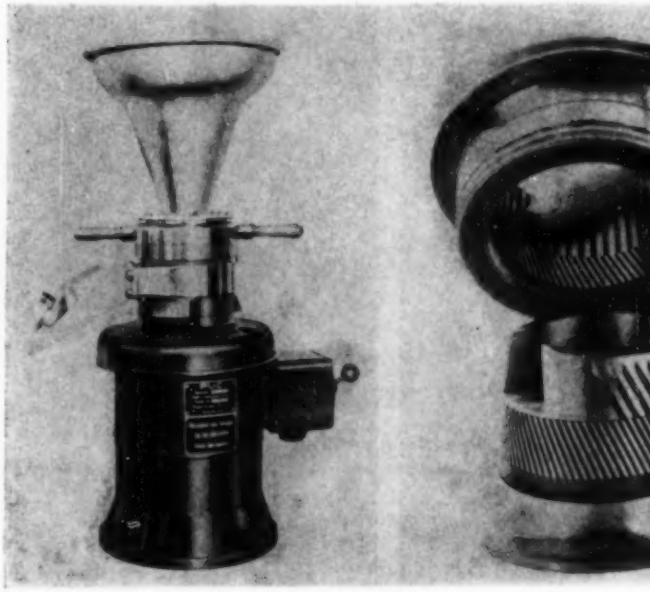

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376 Study on Viscosity of Plastisols. Booklet from Firestone Tire & Rubber Co. titled "Effects of Sheer Rates, Temperatures, and Time on the Viscosity of Plastisols."

377 Nuclear Design and Engineering Services. Data Memorandum from Superior Tube Co., Nuclear Products Division, describes products, facilities, services.

378 New Injection Molding Technique. Brochure from W. R. Grace, Polymer Chemicals Division, details operating technique and specific advantages of new molding technique for thermoplastic materials.

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MATERIALS

386 Propionic Acid Bulletin. D ical properties, specifications, formation, and applications. Un Chemicals Co.

387 Data Sheet on Rare Earth values for melting points, boi density, and atomic radius. Als experimental quantities. Research Inc.

388 Bulletin on Boron Nitride. advantages, uses, price schedule dum Co.

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Earth Metals. Lists
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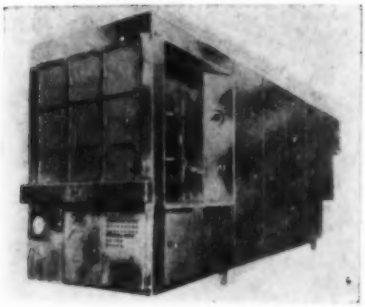


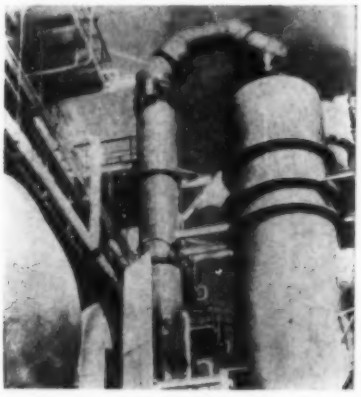
Circle No. 406 on post card

ALL-STAINLESS STEEL SPRAY DRYER

A completely pre-assembled and pre-tested unit is offered by Henszey Co. The pushbutton control center comes complete with starters, fuses, disconnects, and other necessary components.

The new dryer employs the so-called "horizontal air suspension" method, a process that keeps all the powder—even the heaviest particles—suspended in the air during the seven-second drying cycle. This speeds the drying process, gives greater product uniformity, and assures maximum powder recovery. The unit is designed for easy access to all parts for straight through spray cleaning. For brochure with full details, circle Number 406 on Data Post Card.

DEVELOPMENTS OF THE MONTH



Circle No. 407 on post card

NEW EXPANSION JOINT DESIGN

Sixty-seven large expansion joints, of a new design by Badger Manufacturing Co., have been installed in the new Orange, Texas, plant of Firestone Tire and Rubber Co. The process called for hydrocarbon lines with a pressure range from vacuum to 2 pounds absolute, and temperatures from 1,000 to 1,100°F. Air lines operate at 12 pounds pressure, and the same temperature ranges. Hydrocarbon lines vary in diameter from 30 to 48 in., and air lines are 54 and 72 in. The Series 50 (low pressure) joints used by Badger for this installation incorporate a radically different curvilinear corrugation design which results in more uniform movement per corrugation. The all-curve shape of the corrugation results in lower flexing stresses and increased flexibility, even without reinforcing rings. For further details, circle Number 407 on the Data Post Card.

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD
First Class Permit No. 48890, Sec. 34.9, P. L. & R., New York, N. Y.

CHEMICAL ENGINEERING PROGRESS
25 West 45th Street
New York 36,
New York

Postage Will Be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

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CHEMICAL ENGINEERING PROGRESS
25 West 45th Street
New York 36,
New York

Postage Will Be Paid by Addressee

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DESCRIPTIONS of products advertised in this issue

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IFC Equipment Fabrication and Erection. Wyatt's Plastics (Wyatt Metal & Boiler Works).

3R Data on Rotary Sifters. Technical bulletin 503 from B. F. Gump.

4A Entrainment Separators. Bulletin 20 from Otto H. York.

7A Hydrogen Sulfide Generators. Technical data from Girdler.

8L Heat Exchanger Design Data. Bulletin HE from Downingtown Iron Works.

9A Design Data on Stainless Valves. Cooper Alloy.

11A Steam Jet Heaters. Bulletin 3A from Schutte and Koerting.

12L Filter Press Catalog. D. R. Sperry.

13A Comprehensive Valve Catalog. Annin Co.

14L Alarm Gauges and Thermometers. United States Gauge. Div. of American Machine and Metals.

15A Data on Mercury Arc Rectifiers. Bulletin 1288494 from Allis-Chalmers.

16L Metal-Jacketed Gaskets. Catalog from Metallo Gasket.

17A Corrosion-Resistant Pumps, Valves, Piping. Data from Duriron.

18A Quick Couplings. Detailed information from Ever-Tite Coupling Co.

Numbers followed by letters refer to equipment, materials, and services advertised in this issue. Numbers indicate pages, and letters position on the page: L, left; R, right; T, top; B, bottom. A indicates full page; IFC, IBC, and OBC are cover advertisements.

23A Spiral Heat Exchangers. American Heat Reclaiming.

24A-25A Chemical Engineering Catalog and Chemical Materials Catalog. Reinhold Publishing.

26A Mixer Design and Selection Data. Catalog A-27 from Philadelphia Gear.

27A Booklet on Uses of Guar Gum. Describes Jaguar, product of Stein, Hall & Co.

28A Spherical Gas Pipeline Scrubber. Test data from Peerless Mfg.

29A Consulting Services on Use of Sulfur. Freeport Sulphur.

31A Plant Design and Construction. Tellepsen Petro-Chem Constructors.

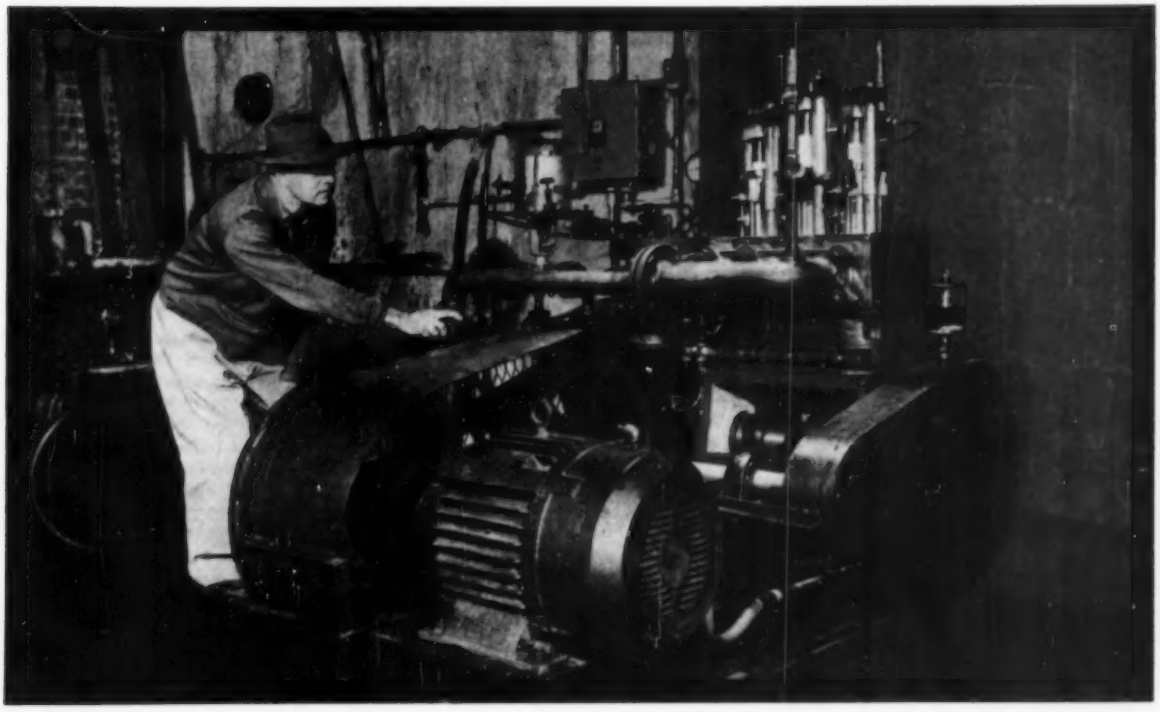
32A-33A Data on Mineral Fillers. Johns-Manville.

34A-35A Plant Design and Construction. Badger Manufacturing.

JACQUES WOLF & CO. SOLVES PROBLEM:

How to maintain constant, undeviating pressure in the production of highly corrosive chemicals

Precise, non-fluctuating pressures must be maintained in continuous processes at the Carlstadt plant of Jacques Wolf & Company. Erratic pressure caused by drop in volumetric efficiency could ruin an entire batch of costly material.



How Jacques Wolf solved the puzzle: Looking for an answer to the problem of holding constant pressure, plus that of increasing production, Jacques Wolf called on Aldrich. Aldrich engineers designed a pump which provided the proper corrosion resistance, fluid velocity and wear characteristics to insure dependable, continuous operation.

Result: After five months of use, the Aldrich Triplex Pump has met all guarantees and proven itself capable of continuous operation. Working 24 hour days, 6 day weeks, the Aldrich Triplex Pump provides the necessary pressure without fluctuation, efficiently handling both alkaline and acidic materials.

We'll be glad to send you full information on Aldrich Pumps and their advantages to you. Simply write Aldrich Pump Company, 20 Gordon Street, Allentown, Pa.

the toughest pumping problems go to ALDRICH

CEP's DATA SERVICE

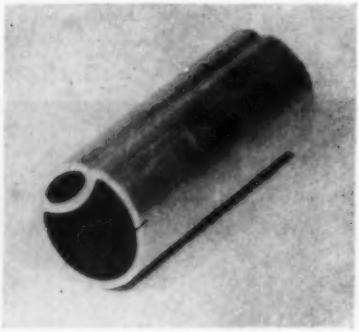
EQUIPMENT *from page 124*

314 New Hydrogen Peroxide Valve. Details from Hamer Valves, Inc. on new specialized valve available in aluminum or stainless steel, in wide range of sizes.

315 Bulletin on Totally-Enclosed Motors. New motors have self-contained heat exchanger cooling for operation in highly contaminated atmospheres. Allis-Chalmers.

316 Precision Proportioning Pumps. Eight-page catalog from Hills-McCanna covers full details and specifications.

DEVELOPMENTS OF THE MONTH



ALUMINUM DUPLEX PIPE
—Circle No. 408 on post card

Now available from Reynolds Metals Co. is aluminum duplex pipe in four sizes, 1½, 2, 3, and 4 inches. It is made in standard 30-foot lengths, and can be ordered in non-standard lengths from 3 to 40 feet. It is available in alloy 3003F or 6063T5.

This type of duplex pipe is adapted to carry steam in one line and process liquid in the other; it has many applications in the chemical, petroleum, petrochemical, paper, and food processing industries. For a brochure giving methods of joining the duplex piping and other technical data, circle Number 408 on Data Post Card.

317 Manual on Glassed Steel Reactors. Covers installation, operation, and maintenance procedures. Pfaudler Co.

318 Small Chemical Pump-Motor Unit. Specially adapted for circulation of corrosive liquids. Capacities to 16 gal./min., heads to 28 ft. Technical details from Goulds Pumps, Inc.

319 Armored Rotameter Bulletin. Constructional information, dimensions, capacities of AR-MET rotameters, designed for pressures to 5,000 lb./sq. in., flow rate equivalents to 3,000 gal./min. of water. Brooks Rotameter Co.

320 Rubber Expansion Joints & Flexible Pipe. Bulletin from General Rubber Corp. describes joints and flexible pipe in three styles: for vacuum, for pressure, and for pressure and vacuum.

321 New Design Gate Valve. Features aluminum body and Nylon seat discs. Operating pressure to 125 lb./sq. in. Bulletins from Jordan Industrial Sales Div. of OPW Corp.

322 Hard Rubber Gear Pump. For low-volume, positive displacement of acids, alkalies, and other corrosives. Details from American Hard Rubber Co.

323 Non-Lubricated Compressor Bulletin. Special compressor cylinders require no oil or other lubricants, due to use of self-lubricating materials in pistons and packing. Ingersoll-Rand.

324 Tubing for Atomic Power. Data memorandum from Superior Tube Co. Includes characteristics and size limits of seven standard tubing materials.

325 Bulletin on Water Treatment Equipment. Lists water impurities and methods of treatment, typical systems, describes aerators, deaerators, precipitation equipment, filters, and ion exchange equipment. Permutit Co.

326 Magnetic Flow Controls in Atomic Plants. Bulletin from Magnetrol, Inc. describes use of Magnetrols in the Experimental Boiling Water Reactor at Argonne National Laboratory.

327 Variable Speed Sieve. Brochure from J. M. Lehmann gives details of the Vorti-Siv, a new adjustable-amplitude, variable speed, non-blinding screen.

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SERVICES
concluded

373 Integrated Nuclear Energy Services. Astra, Inc. offers management assistance, radiation effects research, health physics services, nuclear reactor physics and engineering. Bulletin.

374 Engineering and Construction Services. Brochure from the Refinery Engineering Co. (Treco), Division of Vitro Corp. of America, describes design, engineering and construction services for chemical and petrochemical plants.

375 Computer Applications Service. Computer Applications Laboratory of General Electric, Computer Department, offers brochure on its new facilities for analysis and computation.

379 Industrial Hygiene Aspects of Beryllium. Twelve-page booklet from Beryllium Corp. discusses industrial hazards during extraction and fabrication of beryllium and beryllium compounds.

380 Handling of Petroleum Solvents. Booklet from Esso Standard Oil Co. contains tables and diagrams showing flammability data, explosive temperature limits, and maximum allowable vapor concentrations.

381 Research and Testing on Grinding and Classification. Eight-page bulletin describes Kennedy Test and Research Center, specializing in grinding, crushing, calcining, classifying, conveying, and screening. Kennedy Van Saun Mfg. and Eng. Corp.

PRODUCTS ADVERTISED *from page 126*

36L Rotary Joints. New Catalog 310 from Barco Mfg.

37A Stream Trap Selection Data. Book from Armstrong Machine Works.

38L Metallic Filter Cloth. Catalog E from Newark Wire Cloth.

39A Impervious Graphite Products. National Carbon.

40A-41A Equipment Fabrication in Hastelloy. Vulcan Mfg.

42A Chemical Process Pumps. Technical data from Fairbanks-Morse.

43A Water Supply, Sewage, Waste-Treating Equipment. Infilco.

44A Industrial Furnaces. Petro-Chem Development Co.

46A Data on Organic Acids and Derivatives. Chas. Pfizer.

48A Turbine Type Mixer Bulletins. Turbo-Mixer Div. General American Transportation.

111A Plastic Materials of Construction. Data from U. S. Stoneware.

113A Processing Equipment Catalog. Bulletin 178 from Sprout-Waldron.

115A Process Equipment Fabrication. Graver Tank & Mfg.

116A Filter Data. Croll-Reynolds Engineering.

117A Controlled-Volume Chemical Pumps. Application bulletin 440 and Data Sheet from Lapp Insulator.

119A Gamma Irradiation Unit. Data from Atomic Energy of Canada.

120L Packaged Air Heaters. Technical bulletin from Thermal Research & Engineering.

121A Molten Sulfur Shipping Service. Details from Texas Gulf Sulfur.

122A Plant Design and Construction. Fluor Corp.

127A Chemical Process Pumps. Aldrich Pump Co.

129A Jet-Venturi Fume Scrubbers. Catalog from Croll-Reynolds.

131A Compressor Data. Cooper-Bessmer.

133A Plant Design and Construction. Foster Wheeler.

135A Stainless-Clad Plate. Colorado Fuel and Iron.

136A Vertical Plate Filters. Sparkler Mfg.

137R Rotary Gear Pumps. Technical bulletin from Sier-Bath Gear & Pump.

138A-139L Water Supply Equipment. Layne & Bowler.

140L Selection Data on Safety Heads and Rupture Discs. Black, Sivalls & Bryson.

141A On-Site Air Separation Plants. Data from Air Products, Inc.

142L Teflon Pump and Valve Packings. United States Gasket, Plastics Div.

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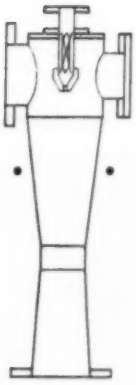
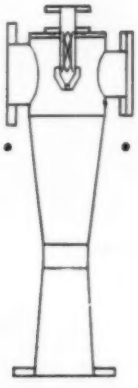


CROLL-REYNOLDS

Jet-Venturi

Fume Scrubbers



minimize odors

clean and purify air

and other gases

without fan or blower

ADDITIONAL APPLICATIONS

to recover valuable solids

use as Jet Reactors

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CEP's DATA SERVICE

EQUIPMENT *from page 128*

328 Impervious Graphite Rupture Discs. Available in six standard increments of 25 lb., from 175 to 300 lb./sq. in. burst ratings. Bulletin from Falls Industries, Inc.

329 Temperature Control Catalog. Nine different types of temperature controls described in condensed catalog. Temperature and current ratings given for all models. Fenwal, Inc.

330 Chemical-Feed Packaged Unit. Improved design specially suited for handling corrosive chemicals. Details from Bird-Archer Co.

331 Pump and Homogenizer Bulletin. Scott & Williams, Inc. offer bulletin describing use of Hydropulse pumps and homogenizers in processing abrasive, corrosive liquids.

332 Portable Oxygen Indicator. Brochure from Mine Safety Appliances Co. describes principles of operation, uses, and accessories.

333 All-Plastic Bleeder Valve. New design in polyvinyl chloride for bleeding, sampling, or drawing off small amounts of liquid from pipe lines, duct systems, tanks. Walworth Co.

334 Liquid Level Sensor. Bulletin from Robertshaw-Fulton Controls Co. gives details of the Batatrol, a liquid level sensor using radioactive material in the sensing element.

335 New Aerostatic Dust Collector. Bulletin contains first published data on new multi-tubular unit, proven for three years in field installations. Hagen Chemicals & Controls, Inc.

336 Catalog on Manifolds for Gases. Twenty-page catalog from Air Reduction Sales Co. describes cylinder capacity, arrangements, and dimensions.

337 Solenoid Valves for Nuclear Reactors. Brochure contains specification and application data for designers of reactor control systems. Automatic Switch Co.

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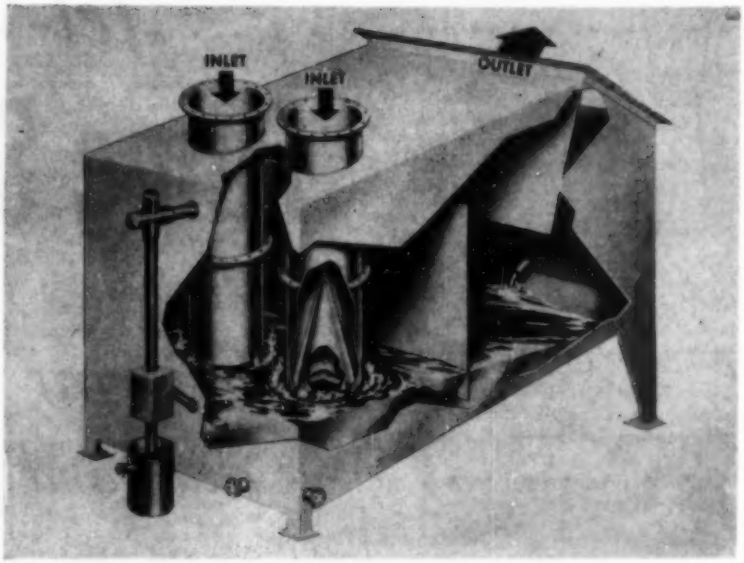
Developments of the month



NEW DESIGN WET SCRUBBER

—Circle Number 409 on post card

The Turbulaire-Doyle Scrubber impinges dust-laden gas at high velocity into a pool of scrubbing liquid. The high velocity impingement causes the gas and dust particles to penetrate deeply into the liquid bath, thus accentuating the wetting action and producing unusually high dust collection efficiencies, even on particles so small that they are in the fume range. The unit consists of a sloping rectangular tank with impingement and eliminator sections separated by a baffle plate across the tank at right angles to the gas flow. The impingement section contains an overflow weir for controlling the fluid level, and a gas inlet nozzle incorporating a cone for increasing the gas velocity. The major percentage of dust collection (or gas cooling) occurs in this impingement section. The eliminator section contains a baffle arrangement for drying the gases before they are discharged from the outlet port. Also located in this section is an inlet for introducing clean scrubbing fluid into the tank as dust-laden fluid flows out. For complete details from Western Precipitation Corp. on this new scrubber, circle Number 409 on the Data Post Card.

PRODUCTS ADVERTISED *from page 128*

143A Book on Waste Disposal Costs. Dempster Brothers.

144L Steam Vacuum Refrigeration Units. Bulletin 60-A from Graham Mfg.

146L Rotary Cone Vacuum Dryers. Descriptive folder from Paul O. Abbe.

147A Data on Double Arm Mixers. Read Standard.

148L-149R Laboratory Testing Apparatus. Bulletins 2185-S and 2292-S from American Instrument.

150A-151A Process Equipment Fabrication. Bethlehem Foundry & Machine.

152L Application Data on Polyethylene. Allied Chemical & Dye, Semet-Solvay Petrochemical Div.

153A Impervious Graphite Heat Exchangers. Data from Falls Industries.

155A Compound Vacuum Pump. Bulletin VP-158 from Roots-Connersville Blower.

156L Research Services on Flakers. Goslin-Birmingham Mfg.

157A Plant Design and Construction. Blaw-Knox.

158L Process Equipment Fabrication, Edw. Renneburg & Sons.

159A Process Simulation by Computer. Service information from Electronic Associates.

160L Spray Nozzle Catalog. Spray Engineering.

161A Worm Gear Speed Reducers. Bulletin 145 from Cleveland Worm and Gear.

163A Heat Transfer Equipment Catalog. Engineers and Fabricators, Inc.

164L Diaphragm Pump Bulletin. T. Shriver & Co.

165A Pulverizing Equipment. Technical data from Pulverizing Machinery Div., Metals Disintegrating Co.

166A-167A Process Equipment Fabrication. Dresser Industries.

168L Heat Exchangers. Ellicott Fabricators.

169A-170A News of New Technical Developments. U. S. Industrial Chemicals.

171R Data on Viscometers. Brookfield Engineering Laboratories.

172L Vertical Pump Data. Bulletin from Lawrence Pumps.

173A Properties of Chromium-nickel Stainless Steels. Booklet from International Nickel.

174L Agitator Selection Data. Bulletin and Data Sheet from New England Tank & Tower.

175A Pan Type Filters. Data from Simco.

176L Process Equipment Fabrication. Manning & Lewis Engineering.

177A Consulting Service on Mixers. Baker Perkins.

179A Details of Compacting Process. Bulletin 07B8836 from Allis-Chalmers.

180L Pulse Code Telemetering Systems. Comparison data from Vapor Recovery Systems.

continued on page 132

Cooper-Bessemer JM Compressors

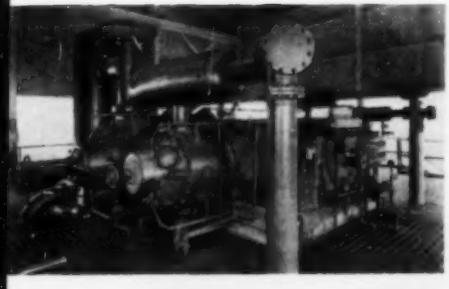
keeping costs low, efficiency high at Sohio Chemical

COMPRESSION, of course, plays a key part in the fertilizer and dry ice plants of Sohio Chemical at Lima, Ohio.

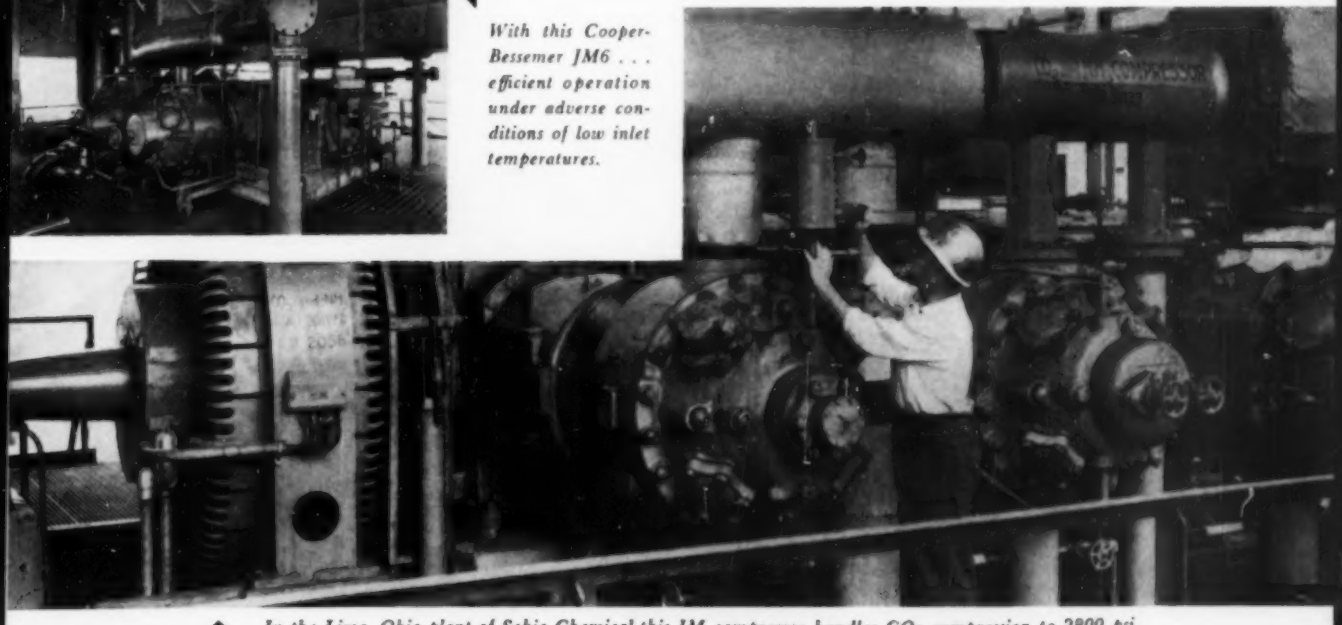
Here, where CO_2 compression runs to 2800 psi, and inlet temperatures as low as –50°F often occur, Cooper-Bessemer motor-driven M-Line compressors live with such severe requirements effectively and economically . . . month in, month out.

One of these units is a 6-cylinder JM rated 1250 hp at 300 rpm, handling the compression of CO_2 to 1200 psi for the forming of dry ice cakes and handling NH_3 for storage refrigeration. The second, also motor-driven, is a 4-cylinder JM rated 1250 hp at 300 rpm. This unit, compressing CO_2 for UREA production, handles pressures up to 2800 psi.

Both compressors boast an enviable record of dependability regardless of demands or operating conditions. Make sure your files contain complete information. Write today.



With this Cooper-Bessemer JM6 . . . efficient operation under adverse conditions of low inlet temperatures.



▲ *In the Lima, Ohio plant of Sohio Chemical this JM compressor handles CO_2 compression to 2800 psi.*

BRANCH OFFICES: Grove City • New York • Chicago
Washington • San Francisco • Los Angeles • Houston
Dallas • Odessa • Minneapolis • New Orleans • Shreveport

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Edmonton • Calgary • Toronto • Halifax
COOPER-BESSEMER INTERNATIONAL CORPORATION . . .
New York • Caracas • Mexico City

Cooper/Bessemer

GENERAL OFFICES: MOUNT VERNON, OHIO

ENGINES: GAS • DIESEL • GAS-DIESEL
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
ENGINE, MOTOR OR TURBINE DRIVEN

CEP's DATA SERVICE

EQUIPMENT *from page 130*

340 Nickel Rotary Gear Pump. Reversible Teflon spur gears, internal Teflon bearings. Pump casing and shaft of pure electrolytic nickel. Eco Engineering Co.

341 New Plastic Vacuum Desiccator. Combines transparency of glass with impact and shatter resistance of plastic. Ace Glass, Inc.

342 Horizontal Vibrating Screen. Heavy-duty CL-Model 58, made by Link-Belt Co., can be cable suspended or floor mounted for use where head room is limited.

343 Buyers Guide for Automatic Controls. Twenty-four-page price list gives typical wiring diagrams of all types of interwired electrical control systems. Automatic Control Co.

344 Teflon-Lined Pipe Bulletin. Describes Chemipipe flanged fittings, flanged rigid pipe, and flanged flexible hose enclosing Teflon liners. Ethylene Chemical Corp.

345 Corrosion-Proof Ductwork. Ervale Corp. introduces porcelain enamel steel duct components under trade name of Erva-Duct. Installation cost said to be half that of stainless steel. Bulletin with engineering data.

346 New Monitor Instrument. Designed to trip when a pneumatic signal violates its minimum or maximum setting. Complete technical data from George W. Dahl, Inc.

347 Pipe Connection Catalog. Specifications, prices on pipe connections, unions, vessel closures, and bleeder valves. Pressures to 15,000 lb./sq. in. Grey Tool Co.

348 Automatic Flow Control. The Flow-Actuated Control, made by Flow-Actuated Control Co. is a simple, positive method to control 3 or more pumps simultaneously. Technical data.

349 Rubber-Lined Storage Tanks. Catalogs from Gates Rubber Co. describe tanks for storage of all types of fertilizer solutions.

350 Centrifugal Pump Bulletin. Single and double suction, single and multi-stage. Frederick Iron & Steel, Inc.

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382 Technical Bulletin on Benzoguanamine. Physical and chemical properties, toxicity and handling, suggested uses. Rohm & Haas Co.

383 Silicone Products Catalog. Basic data on rubber, fluids, resins, water repellents, electrical insulation, release agents, lubricants, paint vehicles, anti-foam agents. General Electric, Silicone Products Dept.

384 Tungsten Carbide Surfacing Powder. Kennametal Inc. introduces Kenspray, a new hard surfacing powder with high tungsten carbide content. Can be applied to steel parts by conventional spraying methods.

385 Polytetrafluoroethylene Base Resin. Booklet from Polymer Corp. of Pennsylvania gives charts and tables comparing properties of this new material to those of Teflon.

389 New Gasketing Material. Uniphase cork is said to offer optimum combination of impermeability, conformability, and chemical inertness. Bulletin from Armstrong Cork Co.

390 Specialty Steels Brochure. Describes application of special steels in construction. Also contains list of recommended technical manuals and aids. Crucible Steel Co. of America.

391 Brochure on Methanol. Applications physical properties, specifications, chart showing properties of water-methanol solutions. Reichhold Chemicals, Inc.

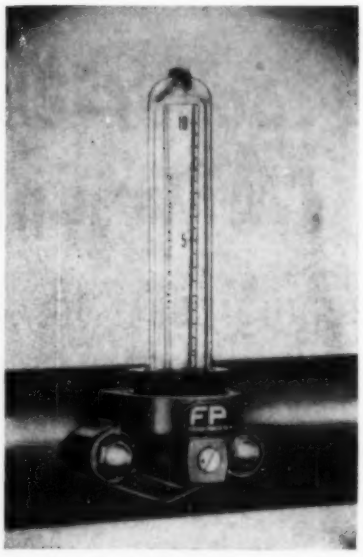
392 Brochure on Hortonclad. Thirty-two-page booklet from Chicago Bridge & Iron Co. describes manufacturing process, lists available cladding and backing metals.

393 Manual on Refractory Brick. Describes correct methods of installing basic refractory brick in the hot zones of rotary kilns. Kaiser Aluminum & Chemical Sales, Inc.

394 Polyethylene Resins. Bulletin from Eastman Chemical Products, Inc. describes wide range of actual and potential uses.

continued on page 134

Developments of the month



NEW TYPE FLOWMETER

—Circle No. 410 on post card

Fischer & Proter has introduced a new type of indicating flow meter, the Mighty-I, that measures flow in either direction and in any pipe size from 1½ to 8 in. without the use of additional components or accessories. The corrosion-resistant flowmeter requires no flanges or matching orifice plates and is easily installed in any line in minutes. It is suitable for services with flow ranges up to 10 to 1. Readings are made directly by means of a ball float and a linear scale calibrated in gal./min. Scales covering flow rates from 3-30 gal./min. to 200-2,000 gal./min. are available. For more detailed information, circle Number 410 on Data Post Card.

PRODUCTS ADVERTISED *from page 130*

181A Chemical Processor. Catalog 117 from Rodney Hunt Machine on Turba-Film Processor.

182L Centrifugally-Cast Pipe. Duraloy Co.

183A Waste Heat Boilers. Bulletin A-60 from Struthers Wells.

184L Metal-Tube Rotameter. Bulletin M-1 from Schutte and Koerting.

185A Technical Services on Chemical Problems. Union Carbide Chemicals.

186A Expansion Joints. Adsco Div., Yuba Consolidated Industries.

187R Free Tantalum Test Kit. Fansteel Metallurgical.

189A Booklet on Tower Packing. Harshaw Chemical.

190L Processed Fullers Earth. Technical data from Floridin Co.

191A Process Tubing. Data memorandum from Superior Tube.

192L Process Equipment Fabrication. Bulletin from Koven Fabricators.

193A Industrial Ion Exchange Equipment. Bulletin 200 from Industrial Filter & Pump.

194L Dust Collection Equipment. Fly Ash Arrestor Corp.

195A Data on Regulators and Controllers. Leslie Co.

197A Carbon Anodes. Great Lakes Carbon Corp.

198L Electrodeless Conductivity Instruments. Industrial Instruments, Inc.

198BR Batch Mixer Catalog. Troy Engine & Machine.

199A Teflon Sealless Pump. Bulletin 511 from Vanton Pump and Equipment.

200TL Conveyors for Bulk Chemicals. Buhler Brothers.

200BL Tank Contents Meter. Bulletin from Uehling Instrument.

201L Tower Packings. Bulletin 11 from Maurice A. Knight.

201R Process Equipment Fabrication. Bulletins from Doyle & Roth Mfg.

202L Industrial Wire Cloth Catalog. Cambridge Wire Cloth.

203A Isotherm Compressors. Data from Brown Boveri.

204TL Magnetic Liquid Level Control. Details from Magnetrol, Inc.

204BL Centrifugal Pump Data. Catalog 5206 from Nagle Pumps.

205A Calcium Hydride Technical Bulletin. Metal Hydrides, Inc.

208L Corrosion-Resistant Pipe and Fittings. Data from Fibercast Co.

209A Nuclear Process Equipment Fabrication. M. W. Kellogg.

210L Process Consulting Services. Samuel P. Sadtler & Son.

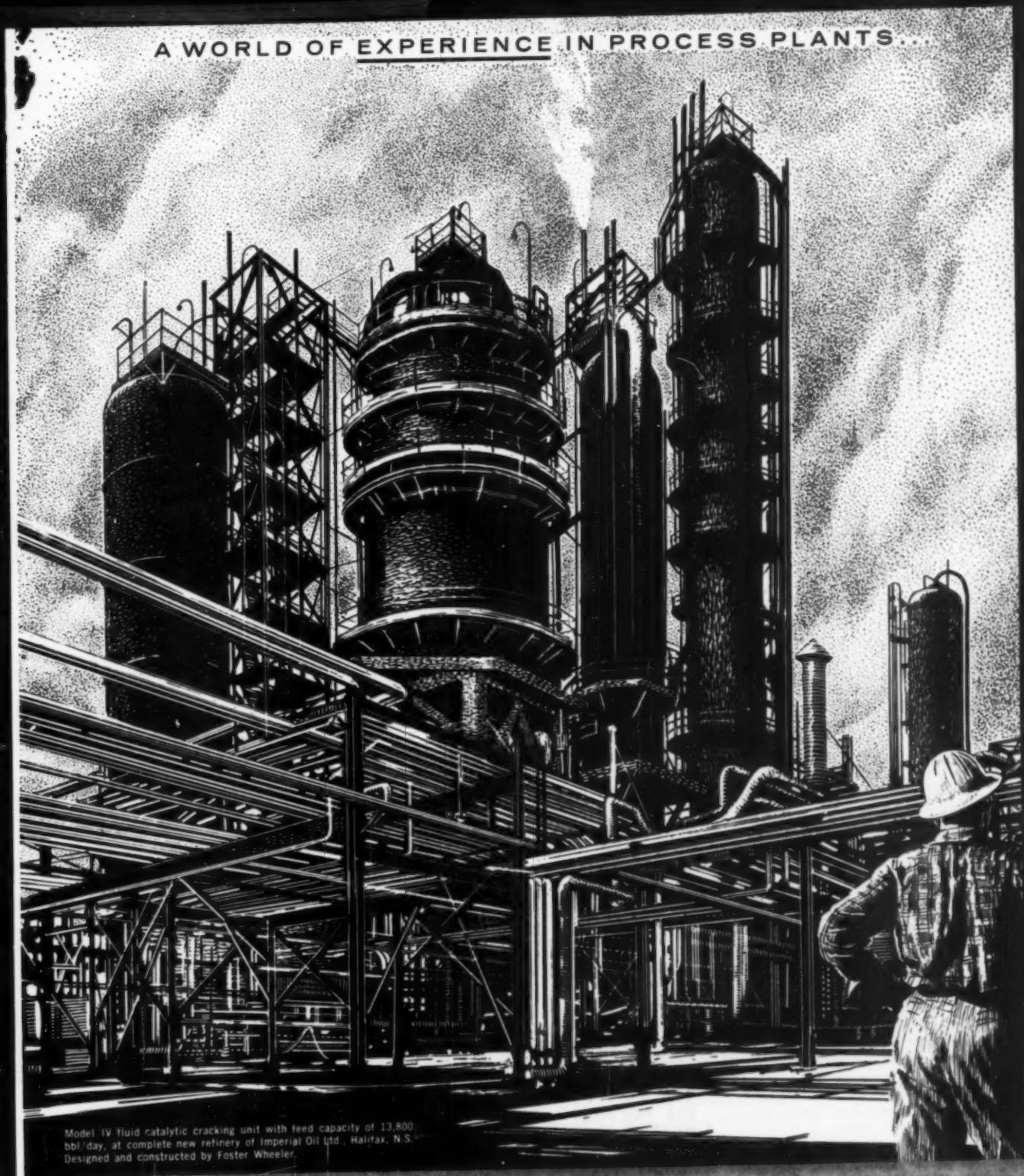
210BR Tower Packing Bulletins. Packed Column Corp.

211A Chemical Transport Barges. Ingalls Shipbuilding.

212L Process Equipment Fabrication. John Zink Co.

continued on page 134

A WORLD OF EXPERIENCE IN PROCESS PLANTS...



Model IV fluid catalytic cracking unit with feed capacity of 13,800 bbl./day, at complete new refinery of Imperial Oil Ltd., Halifax, N.S. Designed and constructed by Foster Wheeler.

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EQUIPMENT *from page 134*

338 New Design Homogenizer. Combines action of impact, attrition, turbulence, and ultrasonic cavitation. Bulletin from Buschman Products, Inc. describes the Jet-Mogenizer.

339 Cone Spray Pipe Coating Machine. Combines heat and high pressure, adjustable to varying diameters, engineered to plant needs. Bulletin from Cleanola Co.

356 Gas Chromatography Equipment. Beckman/Scientific Instruments Division offers data sheet on uses and advantages of two-column gas chromatography.

357 Micro Vapor Pressure Apparatus Bulletin. Describes new high-speed, high-accuracy technique for measuring vapor pressure of volatile liquids. Fisher Scientific Co.

358 Selection Data on Pressure Regulators. To aid in correct application of self-operating and pilot-type pressure regulators. Many graphic tables. Kieley & Mueller, Inc.

359 Pipe Specification Pamphlet. Describes the "Jal-Jacket," made by Jones & Laughlin Steel Corp., a rigid plastic pipe encased in a steel jacket. Specifications, line drawings, engineering data.

360 Centrifugal Collectors. Two design types totaling 41 sizes. Capacities from 260 to 6,500 cu. ft./min. Kirk & Blum Manufacturing Co.

361 Joints for Rubber-Lined Pipe. The Fieldlink joint allows quick replacement or installation of any part of a rubber-lined piping system. Bulletin from La Favorite Rubber Manufacturing Co.

MATERIALS *from page 132*

396 Properties Chart on Thermoplastic Materials. All available, up-to-the minute data on the subject in handy form. Comco Plastics, Inc.

397 Manual on Nonionic Surfactants. Forty-page technical bulletin on adducts of nonyphenol or tridecyl alcohol with ethylene oxide. Jefferson Chemical Co.

398 Eutectic Low Temperature Welding Alloys. Application data from Eutectic Welding Alloys Corp.

399 Itaconic Acid. Technical data and research samples available from Chas. Pfizer & Co.

400 Booklet on Syloids. Typical chemical and physical properties, applications, of eleven micron-size silica products. Davison Chemical Co.

401 Plastic Materials Catalog. 144-page 1958 catalog gives specifications, prices on sheets, rods, film, tubing, specialized plastics. Delta Products Division, Air Accessories, Inc.

402 Data on Molecular Sieves. Properties, application, and description of actual case history of use in curing vinyl silicone rubber. Silicones Division, Union Carbide Corp.

403 Booklet on Sulfur Dioxide. Physical and chemical properties, specifications, suggested uses, toxicity, shipping and handling procedures. Ansul Chemical Co.

404 Modified Epoxy Resins. Bulletin from Duriron Co. describes Durcon, gives mechanical and physical properties, data on corrosion resistance.

Developments of the month

NEW 90 DEGREE SPRAY NOZZLE —*Circle No. 411 on post card*

A new line of FullJet spray nozzles, with the body of the nozzle providing a 90° angle elbow turn, has been introduced by Spraying Systems Co. Where the spray must be directed at a 90° angle to the inlet pipe, these nozzles may be installed without use of additional fittings. Choice of spray angles are offered in the standard 65° angle type and the wide-angle 120° type. For data sheet with complete information, circle Number 411 on Data Post Card.

PRODUCTS ADVERTISED *from page 132*

212BR Air Conditioning Data. Bulletins 112 and 131 from Niagara Blower.

213A Glassed Steel Tank Trucks. Data Sheet 29 from Pfaudler Co.

214A Pump Design Data. Bulletins EM-79 and B-1608 from Peerless Pump Div., Food Machinery and Chemical.

215BL Shaft Packings. Data file DMCEP from Durametallic.

215R Industrial Chemicals. Specifications and data from Tennessee Corp.

216L Fume Scrubbers. Claude B. Schneible.

216BR Gravity Separators. Bauer Bros. Co.

217A Impervious Graphite Pumps. Technical data from National Carbon.

218L Liquid Processing Equipment. Data from Alsop Engineering.

218BR Plastic Materials. Catalog and price list from Kaufman Glass.

219A Low Temperature Separation Plants. American Air Liquide.

220L Spray Nozzle Selection Data. Catalog 5600 from Binks Mfg.

220BR Compressed Gases. Matheson.

222L Experimental Agitator Kit. Bulletin 109 from Chemineer, Inc.

222BR Laboratory Equipment. Catalog 5B from Metalab Equipment Co.

223A Data on Leakproof Pumps. Chempump Corp.

224L Selection Data on Centrifugal Pumps. Bulletin 107 from Frederick Iron and Steel.

224BR Graphite Block Type Heat Exchangers. Bulletin from Delanium Graphite Co.

226L Ion Exchange Filters. Illinois Water Treatment Co.

226BR Air-Cooled Vapor Condenser. Bulletin 129R from Niagara Blower.

227A Chemical Process Valves. Data from Wm. Powell Co.

229A Separators and Pressure Vessels. Ed. W. Smith Machine Works.

230L Thermocouple Wire. Bulletin 1200 from Claud S. Gordon.

230BR Porcelain Tower Packings. Knox Porcelain Corp.

231A Plant Design and Construction. Lummus Co.

232L Fused Quartz Laboratory Ware. Thermal American Fused Quartz.

233A Automobiles. Oldsmobile Div., General Motors.

234L Plastic Pipe Brochure. Kraloy Plastic Pipe Co.

235B Large Diameter Alloy Pipe. Data from Posey Iron Works.

236BL Spray Nozzles. Catalog 24 from Spraying Systems Co.

236BR Bin Level Indicator. Data from Bin-Dicator Co.

240L Plant Design and Construction. C. W. Nofsinger.

241L Fans and Blowers. Heil Process Equipment Corp.

241R High-Pressure Compressors. Catalog from Norwalk Co.

242L Plastic Vacuum Desiccators. Bulletin from Ace Glass, Inc.

243TL Jacketed, Enclosed-Cylinder Disk Filter. Bulletin 19-S from Ertel Engineering.

243BL Heating Coils. Bulletins 355 and 258 from Dean Products.

243R Liquid-Phase Heat Transfer Systems. Bulletin 597 from Parks-Cramer.

244L Heat Transfer Medium. Technical data from Thermon Mfg.

245TL Air Cooling Coils. Bulletins and prices from Rempe Co.

245BL Castings for Process Equipment. Kutztown Foundry & Machine.

245R Encyclopedia of Chemical Technology. Interscience Publishers.

249BM Teflon Packing Data. Brochure from Flexrock Co.

249R Two-Stage Vacuum Pumps. Bulletin 95 from Beach-Russ Co.

IBC Instrument Air Dryers. Anders Lykens Corp., Div. of Milton Roy Co.

OBC Consulting Service on Mixers. Mixing Equipment Co.

A clad "sandwich" being assembled prior to hot rolling. Claymont Stainless-Clad Plates—5 to 50% stainless inseparably bonded to carbon steel backing—offer the corrosion and abrasion protection of stainless steel plus the economy of carbon steel. This is another of the many steel plate products available from Claymont's integrated mill.

by d'Arazien

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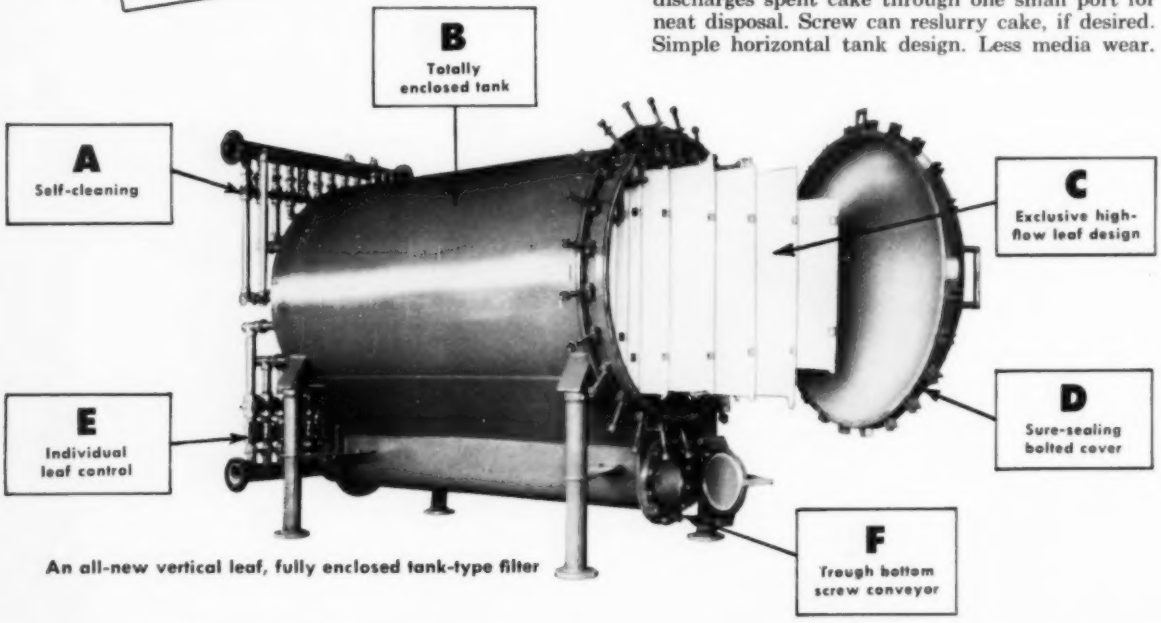
SPARKLER *Presents* NEW VERTICAL PLATE FILTER . . . MODEL RSC

EXCLUSIVE OPERATING ADVANTAGES

Greater Clarity Control—Sight glasses, sample cocks and individual control valves for each leaf provide continuous clarity control. Should any leaf not function properly, it may be shut off without interrupting operation.

Minimum Manpower Required—A single non-skilled individual is capable of operating a large battery of RSC filters including filter aid addition, cleaning, precoating and supervising.

Faster Cleaning, Easier Maintenance—A 560 sq. ft. Model RSC can be cleaned in 10-15 minutes (30-45 minutes total down-time). Leaves are sprayed clean individually. Screw conveyor in trough bottom discharges spent cake through one small port for neat disposal. Screw can reslurry cake, if desired. Simple horizontal tank design. Less media wear.



An all-new vertical leaf, fully enclosed tank-type filter

Exclusive Design Features

A Internal sprays sluice filter. Can be independently valved for individual operation under low pressure conditions.

B No leaking, dripping or air-borne contamination. Assures a neat filter station with clean, sanitary service. Filter may be insulated to minimize heat loss. Can be installed in low headroom, small floor space areas.

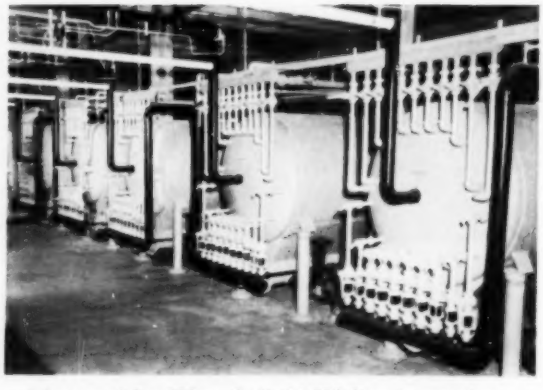
C Vertical rectangular leaf design assures maximum flow per filtering area and even precoating. Unexcelled rigidity and durability. Hung on roller carriages for easy individual inspection or removal, no bolts or fastenings. Self-sealing in filter. Stainless steel leaves covered with long-life synthetic cloth or stainless steel wire screens.

D Bolted cover on double-hung hinge provides full access to interior without leaf removal. Hydraulic quick-opening cover optional.

E Individual plate outlet control valves, sight glasses and sample cocks. Any plate or plates may be shut off without removing filter from service.

F Trough bottom with screw conveyor discharges cake neatly and quickly without opening tank. Cake can be reslurried if desired.

SIZES UP TO 1020 SQ. FT. OF FILTERING AREA



A battery of five 300 sq. ft. Model RSC filters in operation

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Jubilee, June 22-27

from page 114

Mechanics and Materials Selection Methods. There are still important gaps in our knowledge of such common materials as the stainless alloys. Binder (**Stainless Alloys—Present and Future**) pinpoints these gaps, and reviews latest theory and practice. What is the future of titanium and zirconium in the process industries? Assured, says Barron, describing exploratory chemical plant application already under way. (**Titanium and Zirconium in Chemical Plant Applications**). In **Metals of the Future,** Ogden peers ahead to consider high-temperature and corrosion-resistant applications of some of the more uncommon metals—niobium, molybdenum, tantalum, vanadium, tungsten.

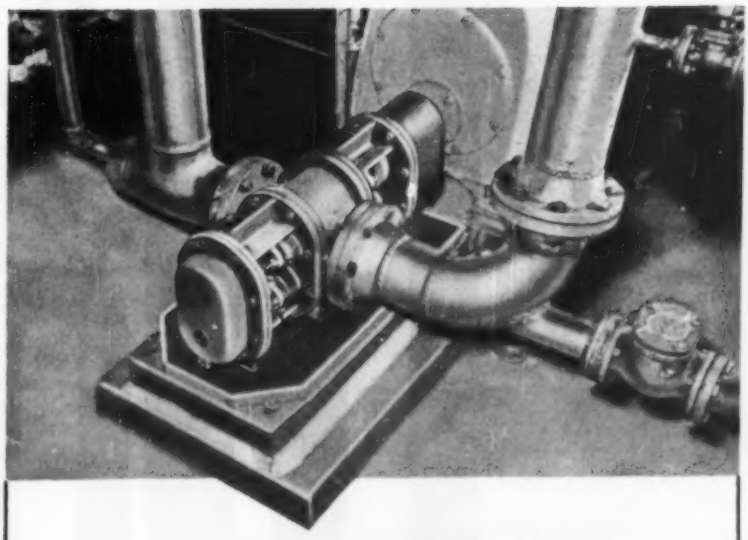
Where are we going in chemical engineering education?

From the first chemical engineering curriculum in the United States, nine papers trace the growth of the science to its present recognized status, and forecast the main currents of future development. Presiding will be F. M. Tiller.

According to Lewis, (**Evolution of the Unit Operations**), three men were chiefly responsible for closing the gap between chemistry and engineering. Davis, who can perhaps be considered a precursor of Chemical Engineering; Walker, who organized the first actual curriculum; and Little, who coined the term unit operations. It is time to consider seriously a re-evaluation and a re-organization of the whole area of chemical engineering education, says Katz, (**Development of Chemical Engineering**), tracing the changing pattern of mehods used at the University of Michigan from the time, 60 years ago, when the subject was taught by chemistry teachers, through the replacement of organic and inorganic technology courses by unified instruction in process design.

The concept of unit opertaions after a slow evolution which followed its original enunciation, is changing swiftly, accelerated by technical demands during and following World War II, says Licht, whose paper, **Present Status of Unit Operations,** goes on to suggest definitions for the future. A **Statistical Analysis of Accredited Chemical Engineering Curricula** (87 in the U. S.) has established a standard procedure for comparing curricula —past, present, and future. Author-statistician is Schmidt. Taking sides in an age-old controversy, Kendall and

continued on page 139



Sier-Bath GEAREX® PUMP
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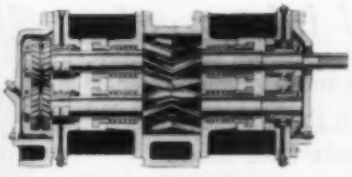
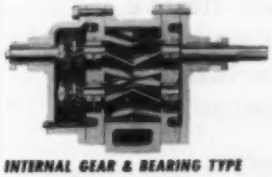
Sier-Bath "Gearex" Pumps



EXTERNAL GEAR & BEARING TYPE
for non-lubricating liquids



INTERNAL GEAR & BEARING TYPE
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Sier-Bath "Gearex" Pumps provide positive displacement, pulseless flow . . . quiet, vibrationless operation. Direct-connected up to 1800 RPM, they require no reduction gears. For high volumetric efficiency and long life there is no rotor-to-rotor or rotor-to-casing contact. Low pressure on stuffing boxes provides easy servicing.

Horizontal or vertical models to handle 32 to 500,000 SSU, 1 to 550 GPM at 250 PSI for viscous liquids, 50 PSI for water. Corrosion-resistant alloys, steam-jacketed bodies, water-cooled bearings, other adaptations to meet individual needs. See "Yellow Pages" for your local Sier-Bath Pump Representative or send for Bulletin G-2. *Sier-Bath Gear & Pump Co., Inc., 9272 Hudson Blvd., North Bergen, N. J.*

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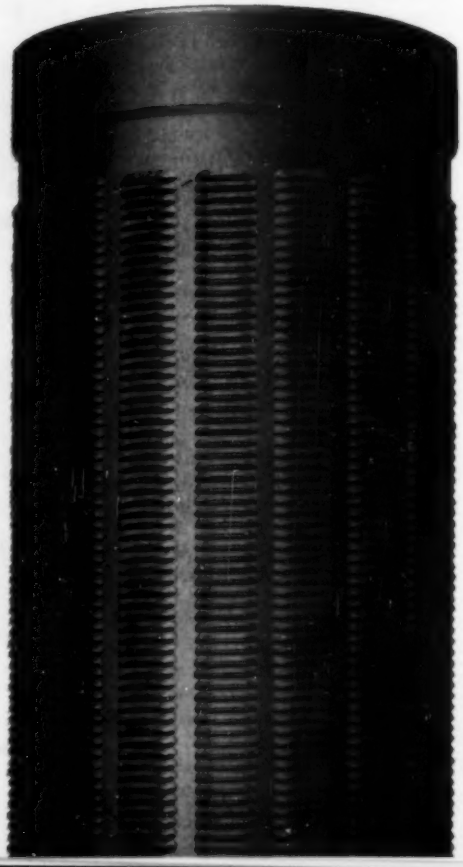

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Jubilee Town, June 22-27

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Calvert (**Some Implications Concerning Chemical Engineering Education**) maintain that principles can best be taught by a study of applications.

More mathematics, combined with training in chemistry and physics, the whole bolstered by a sound background in the humanities, will produce men with the broadest potential as chemical engineers—such is the thesis of Corcoran (**The Engineering-Science Approach in the Teaching of Chemical Engineering**). Says White (**Professional Education in Chemical Engineering**), "A principle objective of engineering education is the development of the ability to solve comprehensive problems involving mathematics, science, and engineering, as well as interactions of human beings in a complex technological society." Two papers take up the problem of graduate work in chemical engineering. After a review of present practice, **Graduate Work in Chemical Engineering** (Kobe), Metzner, in his paper on **Chemical Engineering at the Graduate Level**, goes on to point out that such courses should not be merely an extension of undergraduate work, but should provide a rigorous analysis of the fundamental scientific factors underlying engineering theory and practice.

Trends in chemical engineering education

Industry must take an active part to encourage advanced training of their engineers. Under the chairmanship of W. J. Borns, four papers will discuss what is now being done in this direction—and what must still be done.

Manning, Pyle, and Gibson describe a successful, self-supporting, study course offered by an A. I. Ch. E. local section (**A Technical Study Course Sponsored by an Institute Section**). **An Industry-Sponsored Program with Liberal and Business Courses in Addition to Technical Courses** can do much to extend the engineer's liberal and cultural education in post-college years, maintains Elliott. Cooperation between industry and the academic world is another promising educational path, particularly for those industries located too far from an accredited university to permit direct enrollment of their engineers for advanced study (**A Curriculum Organized by an Industry and a University**, Morgan). Specialized industrial study programs will also play an important role in the future, say Merrill and Lavender (**An Advanced Program of a Specialized Industry**). This type of program is needed because of the growing complexity of the chemical process industries.

The changing field of unit operations—solids area

Mechanical separations, contacting operations, solids transport processes—seven authoritative papers will blanket the field. In the chair will be N. Morash (part 1) and E. E. Ludwig (part 2).

Most devices for handling aerosols can be grouped into relatively few categories according to basic physical principles, says Friedlander (**Gas-Solids Separation, Dry Methods**). The functioning of each class of device can be at least partially explained by application of fluid-particle mechanics. **The Art and Science of Liquid Filtration** is discussed theoretically and practically by Grace. Continuation of the present trend to more complex chemical processes is sure to lead to commercial use of continuous multistage crystallization processes, conclude Findley and McKay, in their treatment of **Separation by Crystallization**. Rushton and Oldshue (**Mixing of Fluids**) emphasize that no single criterion exists for mixing effectiveness. However, any mixing problem can be attacked by results drawn from application of five basic principles.

Further theoretical and practical considerations in solids mixing are brought to the fore by Weidenbaum (**Mixing of Solids**). Calculation of the work required in grinding and formulation of the so-called "grinding laws" are the heart of a paper on **Size Reduction** by Worth. To wind up the session, Marshall goes into the theoretical aspects of solids drying, with emphasis on the internal mechanism of flow and the falling-rate period (**Drying—Its Status in Chemical Engineering**).

Moving forward in process control

To put process control into proper perspective with the rest of chemical engineering has been the purpose of D. M. Boyd and P. S. Buckley in organizing and presenting this symposium. Process dynamics, techniques, organization and personnel—no aspect of the subject has been neglected.

Closer integration of the new control techniques and instrumentation is a must in the design and operation of future chemical process plants, says Roberts, leading off the session with a discussion of **Process Control, a Major Factor in Chemical Engineering of the**

continued on page 140

1500 gal. reaction kettle used in manufacture of phenol formaldehyde resins by Booty Resineers, Inc. A BS&B Safety Head protects this equipment which has a normal operating pressure of 12 psi @ 200° F.

Booty Resineers, Inc. of Newark, Ohio, manufactures phenol formaldehyde resins used for the bonding of many industrial products. BS&B Safety Heads equipped with vacuum supports provide the necessary protection against overpressure conditions in five of their reactor kettles.

BS&B Safety Heads are in service in hundreds of diverse industries throughout the world, providing safety protection to pressured systems. Some of these applications require special coatings for the Rupture Disc to combat corrosive conditions. Many call for special materials and construction to withstand extreme operating temperatures and/or pulsating pressures.

In every case where the BS&B Safety Head Unit is matched to the specific operating conditions, performance has proven quite satisfactory. If you would like some assistance in determining the best type of BS&B Safety Head and Rupture Disc for your particular pressured system, contact your nearest BS&B Representative or write to . . .

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from page 139

Future. How far have we come since 1908 in process control? Bergman's paper, **History of Automatic Control in the Chemical Process Industries,** contrasts the old, the new, and that which is to come. The unsteady-state response of a process to aperiodic disturbances and steady-state response to periodic forcing functions are the key questions of the day in **The Concept of Process Dynamics,** maintains Johnson. He goes on to outline theoretical and experimental procedures for developing dynamic information. **Chemical Reaction System Dynamics,** a sine qua non for process control, are reviewed in detail by Foss.

Measurement Aspects of Process Control come in for a full share of attention in Aikman's paper, which describes the effect of measurement lags on the problem of control. Systems engineering is the answer to many problems in the application of automatic controls to processes, say Williams and Hougen, urging a strenuous research program in the field (**Organization for Chemical Process Control**). Control techniques are by no means confined to the United States, points out Young of I.C.I. (England) in **Developments and Trends in Process Control in Europe**, a paper not to be missed by American engineers in the control field. **What is Ahead in Process Control?** Vannah's paper will analyze trends and economics.

What is ahead in kinetics and reactions

Chemical engineers have, in general, insufficient training in fundamental chemical kinetics, believe Hougen and Syverson, co-chairman of the two sessions dedicated to the subject. Direction of future research in this area is critical, they say.

The point has now been reached where useful engineering predictions can be made on the basis of the theory of reaction rates, claims Hulburt (**Reaction Rates in Chemical Engineering Science**). Problems involving simultaneous transport and reaction are amenable to mathematical formulation. Methods and procedures are outlined in **Transport Process with Chemical Reaction,** by Prager. **Turbulent Transport in Chemical Reactors** is treated in detail, for both laboratory and commercial-scale reactors, by Beek and Miller. A particle of a porous catalyst can be considered as a reactor in which chemical reactions can occur. Hear **Intraparticle Diffusion in**

continued on page 142

Can you use 500,000 or more cubic feet per month of oxygen, nitrogen, or both?

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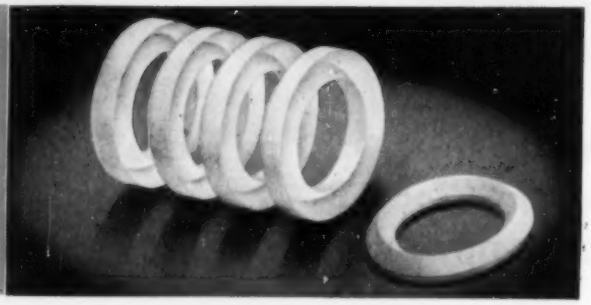
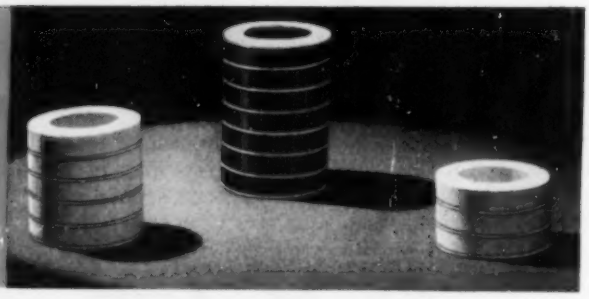
VALVES



Chemiseal† Valve Packings, made of du Pont TEFLON, are available in V-type, diagonal, triangular, conical and Garlock Chevron* ring designs. They last months and years in chemical services where other packing materials fail in hours. They seal at low gland pressure and reduce torque required to operate the valve.

PUMPS



Chemiseal Pump Packings offer remarkably trouble-free service and useful life many times that of other type packings.

Molded from pure shredded TEFLON with TEFLON suspensoid, Garlock No. 9167, for positively non-contaminating service. (Also supplied graphited for general chemical applications.) They provide a low friction 2-way seal not only preventing axial seepage but seal against both shaft and stuffing box as well.

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United States Gasket *Plastics Division of* **GARLOCK**

Jubilee, June 22-27

from page 140

Porous Catalysts, to be given by Weisz.

Wilhelm will discuss latest theory and practice of **Contacting in Packed Bed Reactors,** and Wicke will report on recent studies of **Mass and Heat Transfer in Heterogeneous Gas Reactions.** An up-to-the minute report is Summerfield's paper on **Turbulent Flames Stabilized in High Speed Flow,** dealing with physical and chemical processes in turbulent flames in pre-mixed air-fuel mixtures. Recent unpublished work on the **Stability of Chemical Reactors** (Barkelew) will be of intense interest to engineers.

Investment of company funds in new facilities involves decisions on an engineering level as well as on an economic level. How does the chemical engineer fit into the picture? J. B. Weaver's symposium will provide some surprising answers.

It is part of the engineer's function to combine proper costs and economic forecasts with the purely technical side of process design work, says Tyler **(Economic Evaluation—Ascent from the Past).** The cost of a proposal must not be neglected in assessing the effects of various lines of action on the profit potential of a company, emphasizes Stokes, in his discussion of **Economic Evaluation—Organization and Coordination.** Dybdal **(Economic Evaluation—Inklings of the Future)** predicts that new data-handling and computer techniques will be prime factors in the methods of the future. The need for a single, comprehensive reference source, and for standard terminology in the field of economic evaluation is stressed by Chilton **(Economic Evaluation—Crying Needs).**

Challenges and opportunities in a new and exciting field, new concepts and new technologies in chemical engineering. Presiding will be B. M. Landis.

Space travel, immediate problems and long-range prospects, including a brief film, will feature **The Challenge of the Space Age** by Filbert. Turning to practical chemical engineering, Millard **(New Chemical Fuels—An Engineering Challenge)** will give details of present chemical fuels and propellant systems, and will outline the future as he sees it. Processing of solid rocket propellants is illustrated by a film as a part of the talk, **Chemical Engineering and the Solid Propellant Industry,** to be presented by Stern. **New Chemical Engineering Opportunities in Solid Propellant Applications** (Cooley) will end the session.

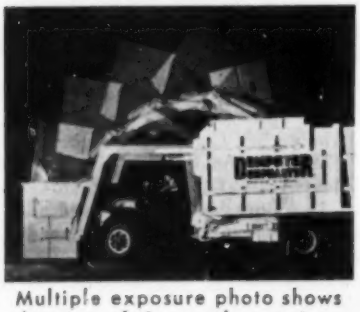
New Invention Cuts Waste Disposal Costs By Two-Thirds in Chemical Processing Plants

Industry Cost Averages May Be Lowered Soon

If your plant is average, you're probably spending between .55 and .85 cents for every cubic yard of waste or trash moved to the disposal area . . . not including truck operation costs.

A recent development, the DEMPSTER-DUMPMASTER self-loading packer, promises to cut direct disposal costs to a new industry low of .07 to .16 cents per cubic yard for volume producers.

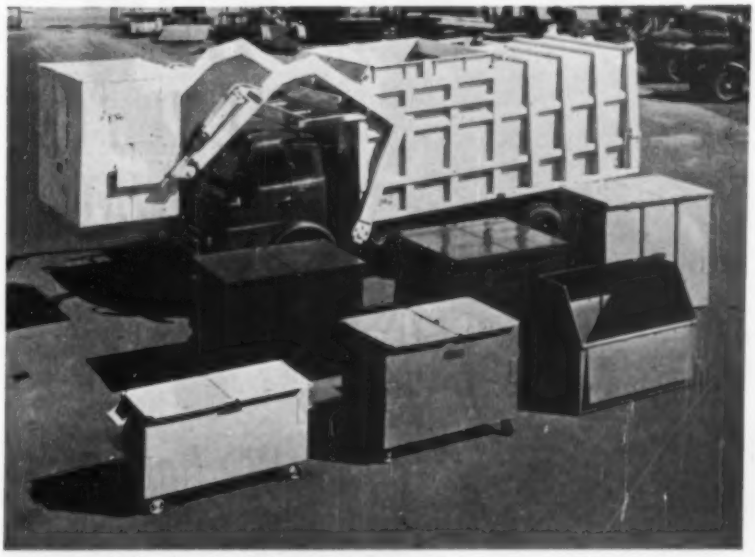
This new approach is an extension of the widely-established DEMPSTER-DUMPSTER System, in that it employs detachable waste storage containers. However, instead of carrying each container to the disposal area for dumping, the new machine empties many containers into its body, where the material is compacted to a fraction of its former volume. This permits per-trip payloads of 50 to 100 cubic yards of loose material, depending on its characteristics.



Multiple exposure photo shows dumping of 6 cu. yd. container.

How it Operates

The one-man Dumpmaster makes its rounds from container to container. Approaching, the driver engages lifting channels on the container's sides with the clearance arms. From controls in the cab, or remote controls at the front bumper, the container is lifted and rotated, discharging waste into the packer body. The material is hydraulically compacted while enroute to the next location. Containers may also be handled from docks or below grade. The safety clearance arms never pass the cab windows, eliminating possibility of driver injury.



The newly developed DEMPSTER-DUMPMASTER is shown with the seven basic containers it serves. Being hoisted is a 6 cu. yd. model. On ground are 1, 2, 3, 4 and 5 cu. yd. designs. Open container is used for hand-loading service.

New "Tracking" Caster Developments Make Plant "Container Trains" Practical

To whip the high cost of moving refuse outside, many plants are going to "container trains." Using special casters and couplers, eight to ten containers are towed by "plant mules" to inside generation points where an empty is dropped off and the full one is coupled on. Outside, the containers are uncoupled and automatically emptied by the waiting DUMPMASTER.

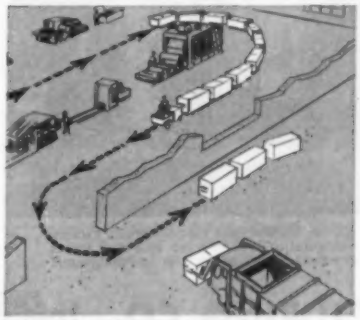


Diagram shows containers, in train, being hauled outside for emptying.

• • •

Many Designs Available

Standard and special-purpose containers, ranging from one through six cubic yard capacity, with or without casters, are available. The two cubic yard container above holds the equivalent of over 12 30-gallon trash cans.

Cost-Finding Book Offered

Write for the free 40-page book, "How to Cut Waste Disposal Costs," offered by the manufacturer. It contains cost-finding formulas, solutions to problems, case histories, industry average costs, etc. Equipment demonstrations arranged on request.

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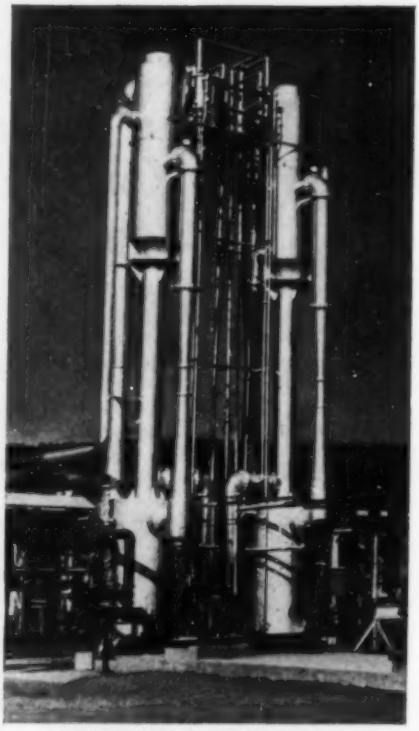
If you are going to need cold water this summer, now is the time to do something about it.

Graham Steam Vacuum Refrigeration will operate on steam pressures from 1# per square inch and up. Water versus steam requirements may be balanced.

It is really economical, proved in reliability and low in all costs. Call on us for an estimate without obligation. Or write for our Bulletin 60-A.



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Polymers for High-Temperature Service, W. Brenner and C. J. Marsel, NYU.

Heat Resistant Alloys for Use at Temperatures Above 1000°F., K. B. Young, International Nickel Co. of Canada.

Titanium—The Newest Structural Metal, W. M. Winkler, Titanium Metals Corp.

The above are $0.50 each, $1.50 per set.

The Hazards of Noise Exposure, W. Rudmose, Southern Methodist U.

The Measurement of Noise, L. S. Goodfriend, Editor, *Noise Control.*

Noise With Your Chemicals?, G. L. Bonvallet, Rvsdon Products Co.

Methods of Noise Control, T. F. W. Embleton, National Research Council, Ottawa.

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Survey of Digital Computer Programs in the Chemical Industry, G. R. Trimble, Jr., Computer Usage Co.

Models Build More Economical Plants, T. S. Tucker, The Fluor Corp.

Techniques in Modern Fabrication, P. O. Leach, Combustion Engineering.

Modern Construction Methods Reduce Costs, R. W. Hudson, Foster Wheeler.

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ASME/IRD Preprints of A.I.Ch.E. Papers

A Technique or Optimizing Process Conditions, A. L. Hoerl, Du Pont.

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A message for young physical scientists & engineers

from James H. Doolittle, Chairman, NACA

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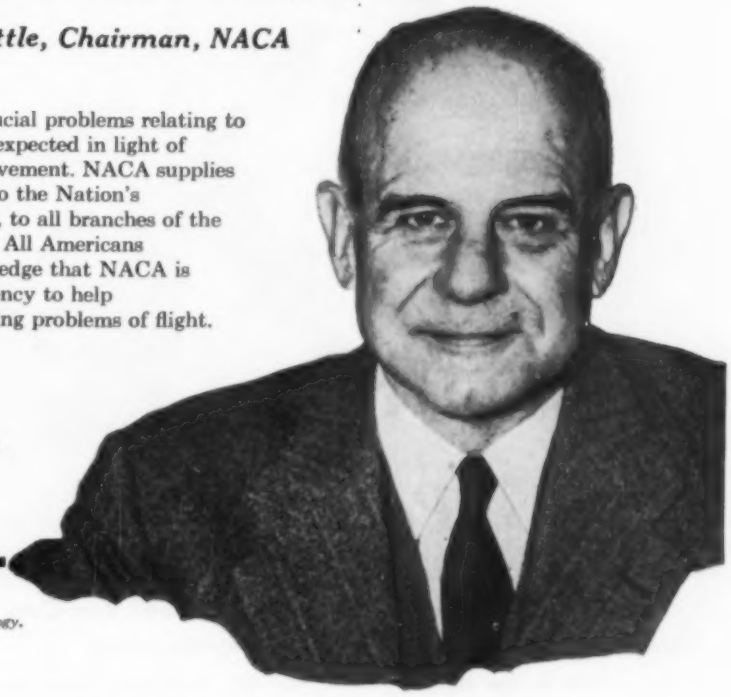
James H. Doolittle



James H. Doolittle, Chairman, NACA; Sc.D., Massachusetts Institute of Technology.

NACA has a staff of 7,750 research scientists and supporting personnel spread among centers on both Coasts and in Ohio. NACA staff members in pursuit of new knowledge have available the finest research facilities in the world, including several of the largest and fastest supersonic and hypersonic wind tunnels, hot jets, a fleet of full scale research airplanes, which will include the X-15, hypersonic ballistics ranges, shock tubes, a nuclear reactor establishment, rocket facilities, a research missile launching site, tracking devices, and the most advanced mechanical and electronic computers.

NACA Fields of Research Include: Aerodynamics, Aircraft and Missile Structures, Materials for Aircraft and Missiles, Automatic Stabilization, Propulsion Systems, Propulsion Systems Structures, Rocket Systems, Solid State Physics, Fuels, Instrumentation.

A number of staff openings are becoming available. You are invited to address an inquiry to the Personnel Director at any one or all four of the NACA research centers:

Langley Aeronautical Laboratory, Hampton, Virginia
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High-Speed Flight Station, Edwards, California

(Positions are filled in accordance with the Aeronautical Research Scientist Announcement 1B)

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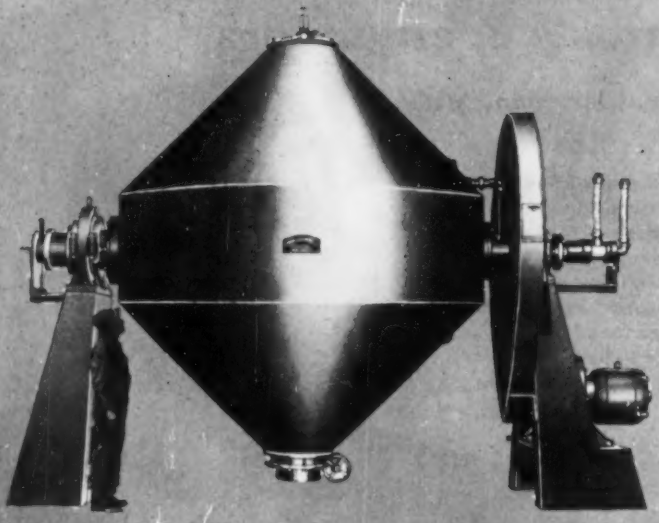

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Cheaper metals

from page 120

vacuum arc melting. Electron beam operations can be stopped and started at any time. In arc melting a valuable ingot is often lost if it becomes necessary to halt the process. The new electron beam process can melt material in any form, such as ingot, powder, flake, or sponge. The arc process usually requires compacted material.

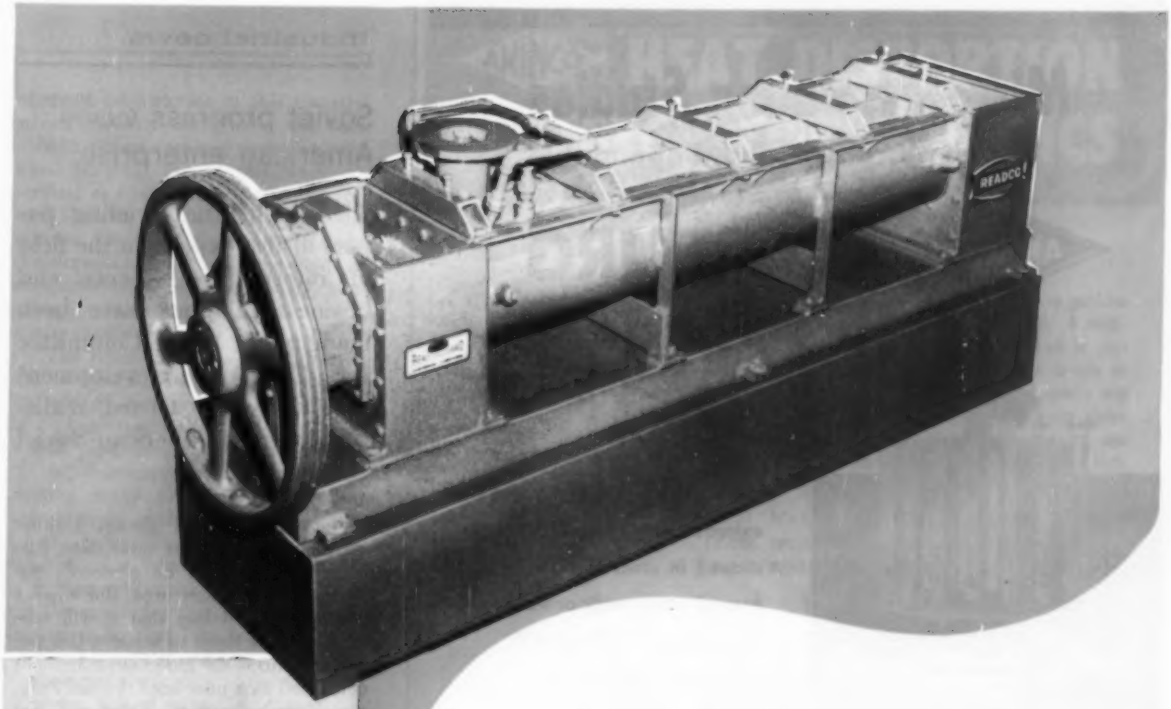
The process differs in principle from vacuum arc melting not only in the heating mechanism (high-voltage electron bombardment rather than a low-voltage electric arc), but also in the level of vacuum used which is in the range of .01 to 0.1 microns rather than 10 to 100 microns. Under the conditions existing in the furnance, carbon, hydrogen, and oxygen generally are removed rapidly as carbon monoxide, metal oxides, or similar compounds. As a rule, impurities which form compounds having a vapor pressure of at least 10^{-5} atmospheres at the surface of the melt can be removed easily.

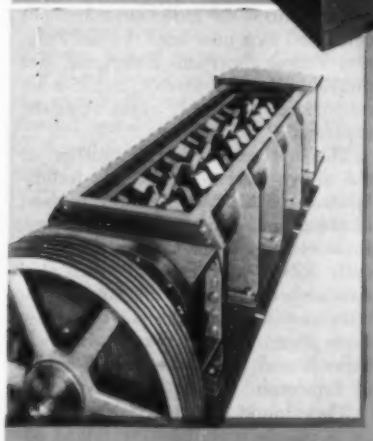
The process can also be used for zone refining. In some respects, it should prove superior to present zone refining processes. One big advantage of electron beam melting is that there is no apparent limitation on the diameter of the bar or ingot that can be processed.

Economics promising

The economics look favorable to the three companies at the present stage of development because high voltage d.c. electrons are relatively cheap and power efficiencies are high. The purifiction of columbium requires about 3 to 4 kw.-hr./lb. The power requirement for tantalum is about 6 to 8 kw.-hr./lb. By comparison, the solid state sintering of tantalum uses 500 kw.-hr./lb. Tantalum, molybdenum, and other metals have been produced in higher purity than ever known before. Ductile columbium, previously only a laboratory curiosity made by solid sintering, is now a commercial reality, according to the companies. One industrial customer has made ½ mil columbium foil from a 3-in. ingot by cold rolling without annealing.

A plant expansion doubling the capacity for commercial hydrogen at the Kansas City, Kansas, plant of NCG Division of National Cylinder Gas Co., has now been completed. #





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For further information on Readco mixing equipment, see Chemical Engineering Catalog pages 1483 to 1490.

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(rotary or rectangular) with controlled temperatures ranging from 3° C above ambient to 50° C.

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Soviet progress vs. American enterprise

The confidential briefing papers of five experts in the field of international science and business relations have been made public by the Committee for Economic Development (CED), paint a hard, realistic picture of American-Soviet competition today.

"When I really feel gloomy I think that five years from now they (the Soviet Union) will be obviously superior to us in every area. But when I am optimistic I feel that it will take ten years for them to achieve this position." This is the gloomiest statement contained in a new book, *Soviet Progress Versus American Enterprise*, just published by Doubleday, but it is by no means the only grim opinion expressed.

The not-very-optimistic author of the above statement is Prof. Jerome Wiesner of MIT. His fellow authors of these once-confidential reports are: Presidential adviser Clarence B. Randall; Edward L. Allen, director of economic research of the Central Intelligence Agency; Prof. J. Sterling Livingston of Harvard Business School; and Prof. Warren W. Eason of Princeton.

They found the Russians ahead of us in missile propulsion, technical education, some fields of research, in their weapons system decision-making processes, and possibly even in some aspects of military readiness.

Wiesner said that many things have been done in Russia to facilitate scientific development that find no counterparts in the West. "There is clear-cut evidence," he said, "that the scientific, technical, and even (in some respects) the cultural training that the students are given in the good high schools exceeds anything but that provided by the very best schools here. In college, the students are required to work harder, so far as I can tell, and consequently are better trained."

Of the Soviet training and research done in "institutes" associated with their Academy of Science, he said there is "no real equivalent in this country."

In striking contrast with the gov-

ernment laboratories in this country, which Wiesner said "have not been able to attract and hold first-rate technical people," the Soviets were described as having their best technical and research workers in separate institutes specializing in research and development in such diverse fields as computer facilities, meteorology, metallurgy, radio and electronics, and space exploration.

"The Russian state is an interesting one in relation to science," the professor added, "because in a real sense it is a pioneering nation, a nation with a real pioneering spirit, even though it is dominated by dictatorship. Among many of the workers, and among many of the scientists, there is, to us, a discouraging amount of enthusiasm for what they are doing."

Professor Wiesner gave Soviet leaders the credit for seeing, as the intellectual does, that "the frontier is not the land but the mind."

Professor Livingston of the Harvard Business School urged that research and development be taken away from the armed services and put into a new civilian agency like the wartime Office of Scientific Research and Development.

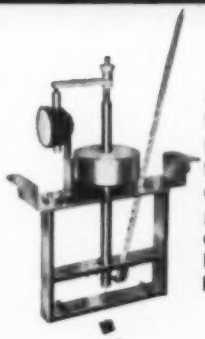
Clarence Randall, former steel executive who now advises President Eisenhower on matters of foreign trade, noted in some detail the skill and effectiveness of the Soviet economic offensive, and gave three reasons why businessmen should support economic assistance to underdeveloped countries.

These were that our own country will be increasingly dependent upon overseas sources for vital raw materials, that the underdeveloped countries have the greatest undiscovered raw material assets, and that as they develop these countries will provide markets for American exports.

He spoke highly of the trading skill of Mr. Mikoyan, whom he described as "the greatest traveling salesman in history." How, he asked, can free enterprise compete with "a man who not only can sell every product his country produces, but can cut the price without asking anybody?"

"They also beat us all hollow in what we know as technical assistance," Mr. Randall asserted. He told of the ease with which they could send their good technicians anywhere, and of their knowledge of the languages of the countries to which they went. All in all, he said, it was "tough competition."

AMINCO HEAT DISTORTION TESTER FOR PLASTICS



ADAPTABLE TO VICAT SOFTENING-POINT TESTS

Increased use is being made of this instrument to perform Vicat Softening-Point tests of polyethylene samples. A modification kit for the standard instrument is required to perform this test which, in brief, applies heat to the sample at a rate of 5/6° C per minute, until a flat-ended needle will penetrate a polyethylene specimen to a depth of 1 mm under a load of 1000 grams. With the Vicat Modification Kit, the Heat Distortion Tester can perform heat distortion tests on both hard, rigid thermoplastics, and softer, elastic thermoplastics.

Vicat Modification Kit Includes:

10-206 SPOOL & ADAPTER.....$85
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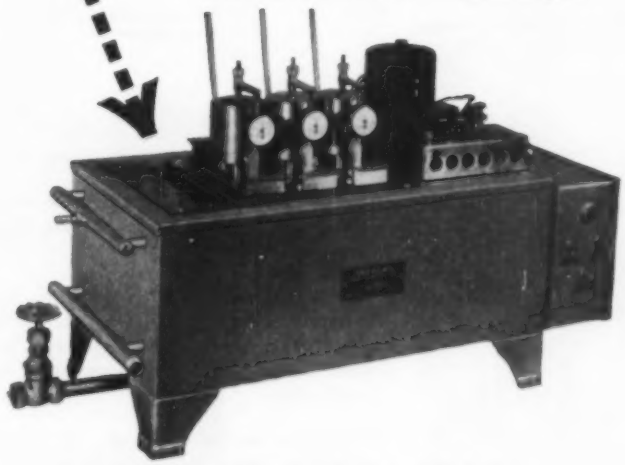

Complies with ASTM Standard Test D-648

This easy-to-operate instrument determines the degree of heat at which distortion occurs in various types of plastic samples, in accordance with ASTM Standard Test D-648. It accurately controls the rate of heat increase at 2° C per minute, and reflects the degree of distortion of the plastic samples on dials mounted in the specimen holder. It may also be set to maintain constant temperatures up to 150° C.

Four Specimens May Be Tested Simultaneously by placing each in a specimen holder, as shown above, and lowering it into the insulated metal bath. A modified model of the Heat Distortion Tester can be supplied for operation at temperatures up to 260° C on special order.

10-201 HEAT DISTORTION TESTER.....$1,210

Complete with four specimen holders and four thermometers

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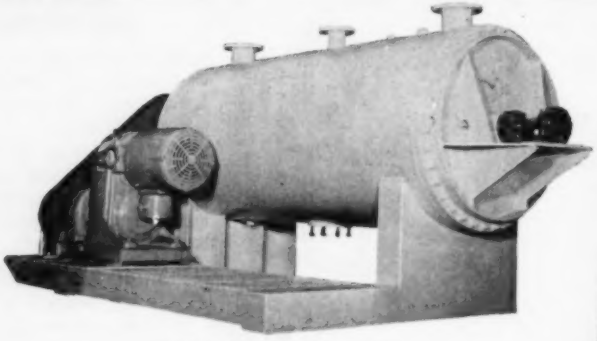
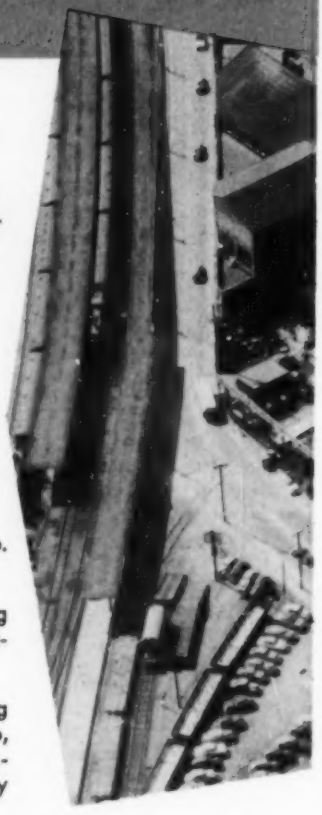


Fabricated Horizontal Dryer complete with drive.



Jacketed and plain reaction vessels with or without agitation.

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This experience and these skills plus our manufacturing facilities, which include Pattern Shop, Foundry, Machine Shop, Fabricating Shop, and X-ray Department, assure you equipment that is efficient, economical to operate and highly productive.

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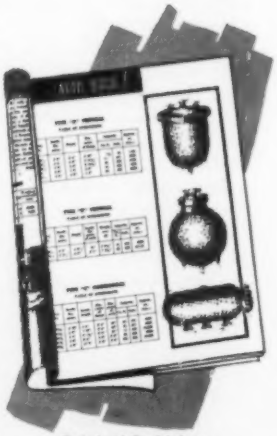
We will be glad to send you technical bulletins featuring the types of equipment in which you are interested. Write us today.



Original Bethlehem Catalog, circa 1900.

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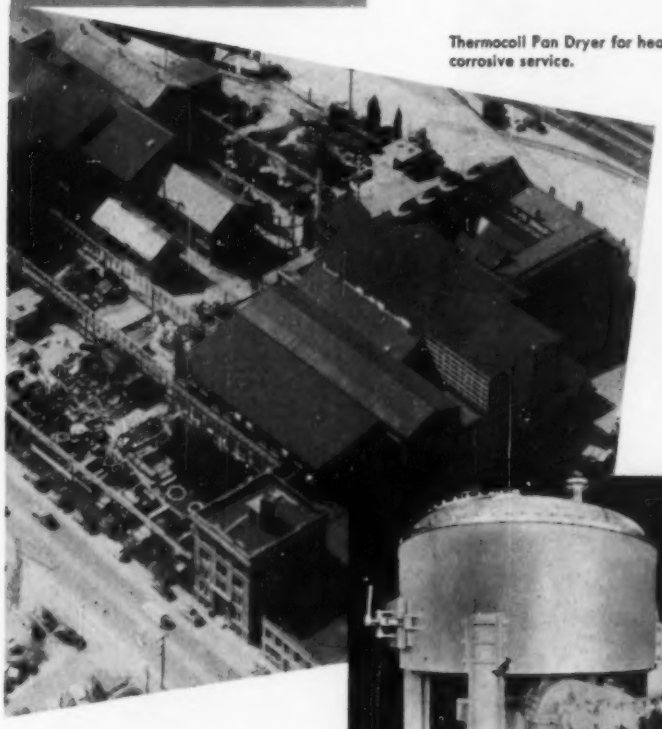
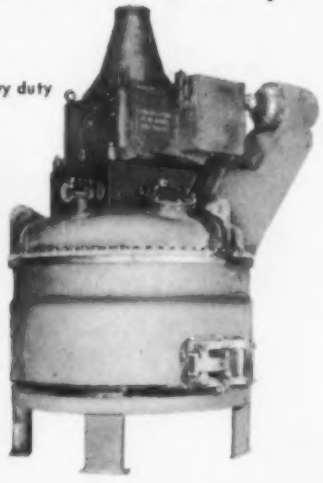
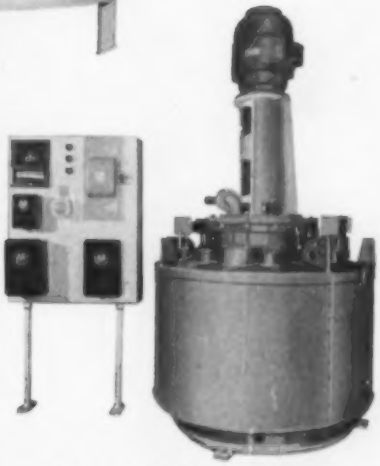


Fabricated Pan Dryer processing heat sensitive organics.

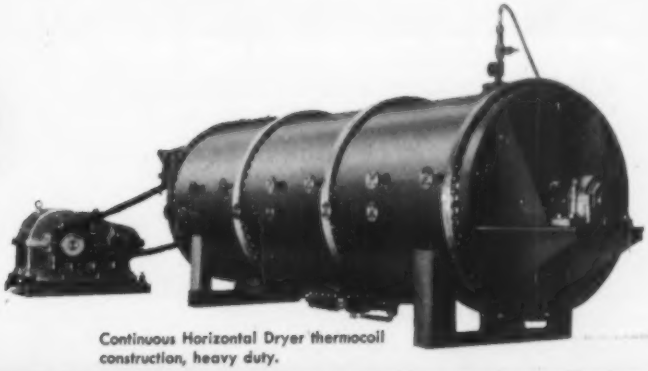


Thermocoil Pan Dryer for heavy duty corrosive service.



Laboratory model Beth-Tec unit available in ½ to 5-million BTU per hour duty.

Fabricated items typified by heated dryer head.



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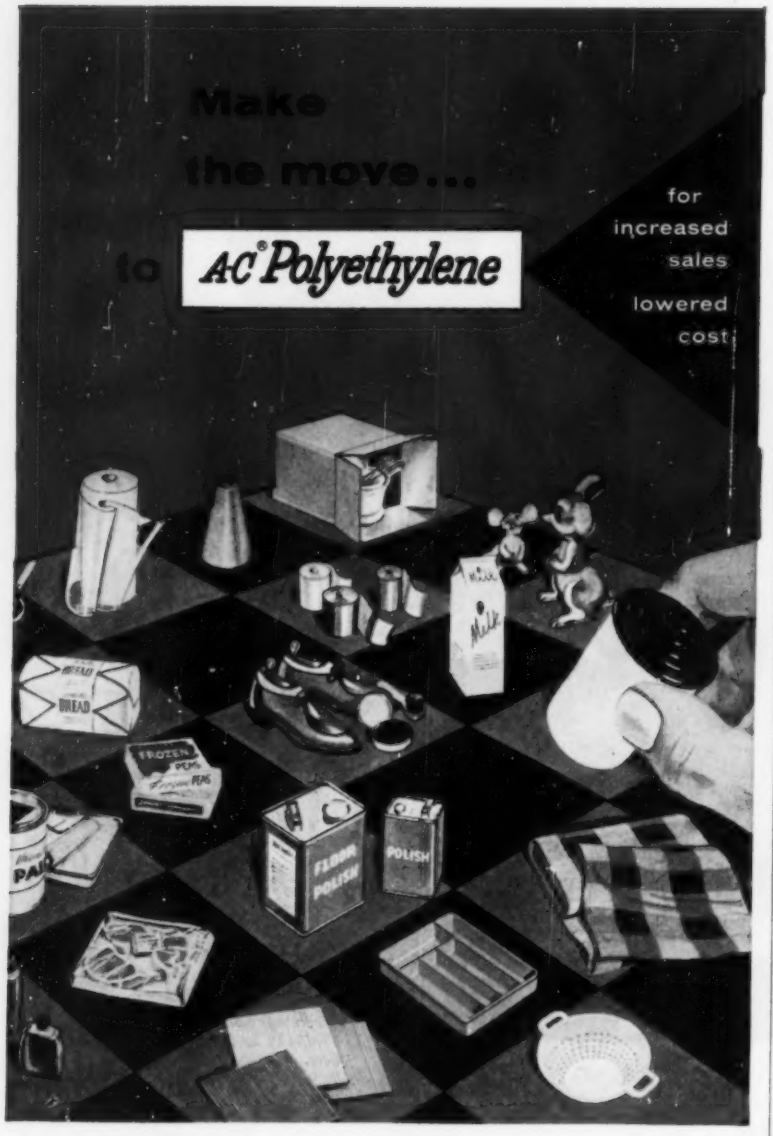

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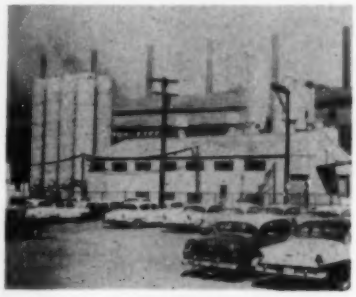
Allied Chemical

industrial news

A phthalic anhydride plant will be built by Kolker Chemical at its Newark, N. J., plant. The new unit will have an annual capacity of 15 million pounds. Completion is expected by the end of 1958. #

A new polyester resin for use in the production of synthetic fibers has been developed by Goodyear, will be produced by the company under the name of Vitel. The resin is an orientable, crystallizable, linear copolymer, and is just one of a family of resins according to the company. Goodyear will produce the resin in a new $9 million facility at Apple Grove, W. Va., while the actual spinning will be done by a fiber producer. One of the textile mills to be supplied is Beaunit Mills, which has already begun construction of a $10 million plant to spin fiber from Vitel. Capacity of the textile mill will be some 10 million pounds a year. #



Two more Linde Company (Carbide) **"captive" oxygen plants are on stream** at steel plants. One, at Detroit Steel's Portsmouth, Ohio, plant, will produce 20 million cu. ft. of high-purity (99.5%) gaseous oxygen a month for use in furnace operations as well as normal steel mill activities. The plant pictured above, will automatically produce oxygen at the rate required by Detroit Steel's operation. The second plant is at Pittsburgh Steel's Monessen, Pa., Works, will produce 126 tons of low-purity (95%) oxygen a day, and about 14 tons of high-purity a day. #

A new series of high solvency, fluorine-containing alcohols provide a convenient means of introducing fluoroalkyl groups into organic molecules according to Du Pont which has recently developed the new series. In addition, Du Pont says, the compounds show promise as intermediates in the development of new plastics, surface-active agents, lubricants, elastomers, and plasticizers with exceptional thermal and chemical stability. #

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The CROSS-BORE exchanger is composed of only three parts: (1) "one-piece" heat transfer cylinder, drilled longitudinally and laterally to permit passage of the two fluids or gases, (2) shell, and (3) domes. CROSS-BORE exchangers have been proving their unique value in field service for over 4 years.

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CCDA holds major rubber meeting

By 1965, the world's production of synthetic and natural rubber will reach approximately 4 million long tons. On this point, there was substantial agreement among American and European experts gathered together at the recent (March, 1958) meeting of the Commercial Chemical Development Association in New York.

The question of how the twenty percent increase in productive capacity will be split between synthetic and natural rubber was of immediate interest. Shifts in the types of synthetic rubber were discussed, and entirely new developments predicted. On the floor for debate, also, was the future for the chemical companies who produce the raw materials and intermediates for synthetic rubber. On these, and other subjects, the assembled experts peered into their respective crystal balls and came up with some interesting, if sometimes contradictory, opinions.

WORLD RUBBER CONSUMPTION

(Thousand Long Tons)

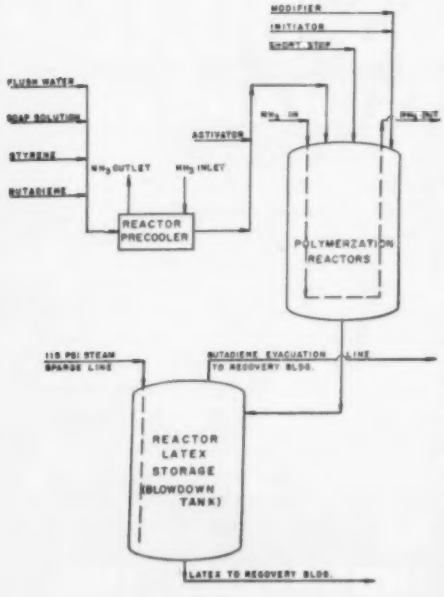
Area	1956 Natural	1956 Synthetic	1956 Total	1960 Estimated	1965 Estimated
USA	562	874	1436	1565	1724
W. EUROPE	649	153	802	873	962
E. EUROPE	209	350	559	609	670
REST	485	105	590	643	707
WORLD	1905	1482	3387	3690	4063
%	56.25	43.75	100	–	–

"In the European scene," said A. J. Pickett, editor of **Rubber and Plastics Age, London,**" synthetics and plastics will continue to gain over natural rubber. Together, they constitute what is probably the biggest growth industry of all time. . . . Once the Free Trade Area is established, the supply of synthetic rubber to Europe may resolve itself into direct competition between the economic potential of East and West. There will be great scope for butadiene-styrene, nitrile, butyl and neoprene rubbers, in addition to newer polymers such as *cis*-1, 4 polyisoprene and polybutadiene, ethylene-propylene copolymers, and the polyurethanes."

Price instability in the natural rubber market, in addition to strategic considerations, has been an important factor in stimulating the growth of the synthetic rubber industry, both in Europe and in the United States, pointed out Pickett. For example, he cites, the price of natural rubber jumped from 13½ cents in 1922 to 123 cents in 1925 as the result of legal restrictions which severely curtailed exports of natural rubber from Malaya and Ceylon. Again, in more recent times, the price started to rise sharply in 1950 as a result of the artificial rubber shortage created by the

continued on page 158

Changes in equipment design feature new synthetic rubber plant



Improvements in the design of major pieces of operating equipment, and careful attention to economical plant layout, are spotlighted at the new Louisville, Ky., plant of the American Synthetic Rubber Corp.

Adjacent to an existing facility, the new unit, on stream since mid-1957, is designed to produce 25,000 long tons per year of a single type of SBR rubber on a batch basis. Design and construction were by Walter Kidde Constructors.

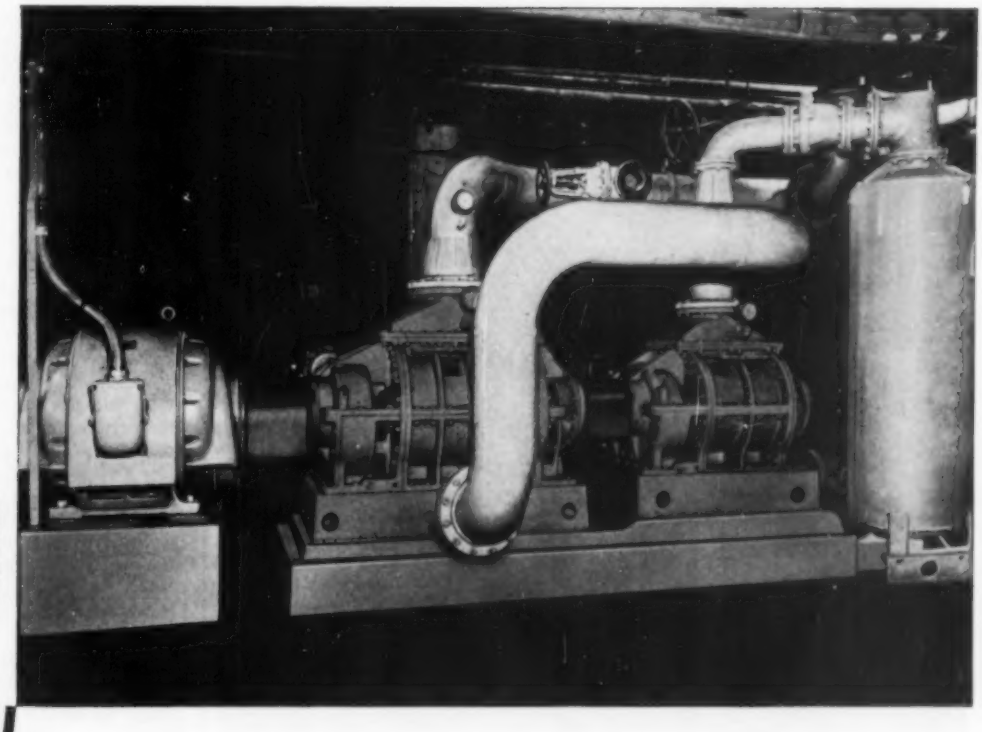
In the layout of the tank farm there are two 30,000 gallon horizontal blend tanks equipped with the necessary pumps for the blending of fresh and recycle butadiene. Volumes of the stocks are measured by metering. In-situ mixing of the components eliminates the necessity of pump recirculation to insure adequate blending. Removal of inhibitor from the butadiene is accomplished by use of water and caustic contactors followed by decantation. Design of the contactors represents a departure from the original design of this type of equipment as used in older plants in that they operate horizontally instead of vertically. The entire set of baffles is mounted on rods and can be removed as a unit for easy cleaning like a tube bundle from a shell.

The reactor area (see diagram) contains all auxiliary equipment necessary to charge the reactors automatically and to store the unstripped latex in preparation for transfer to the recovery area. The reactor section proper consists of twelve units of 3,750 gallons each, with internal ammonia refrigerant coils which control the reaction at the required 41°F.

Polymerization of the monomer occurs after emulsification in a soap

continued on page 156

FOR CHEMICAL AND ORE PROCESSING



RCV-2 vacuum pump—16x35 and 14x24 in compound arrangement, rated 7740 cfm at 22" Hg vacuum, operating at 900 RPM with 294 HP.

NEW R-C compound vacuum pump arrangement simplifies installation

With a new "straight-through" drive design for compound vacuum pump applications, Roots-Connersville has not only simplified piping arrangements but has also further reduced installation time and costs. This new development features a drive-through arrangement with the second stage pump driven directly from a shaft extension on the first stage pump. This permits the use of a standard single shaft extension motor drive. Other pump improvements provide for operation at higher speeds giving more CFM per dollar.

In addition to simplifying installation of the piping, this arrangement provides for easier servicing and maintenance of both pumps and motor. Installations of this new arrangement in chemical plants, uranium and taconite processing plants and paper mills have completely substantiated its advantages in long, uninterrupted performance.

Here is another reason why you can depend on Roots-Connersville equipment for vacuum service to deliver the finest overall performance and dependability at low cost . . . a reputation proved for generations in the country's leading industries.

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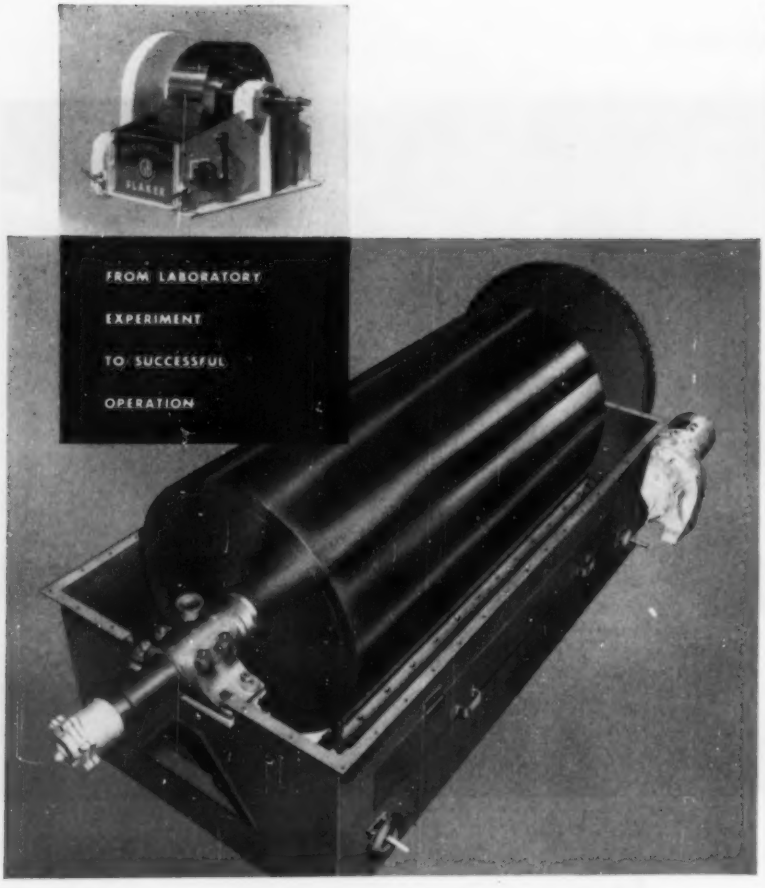

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Fixed directional flow of cooling medium at a predetermined velocity is provided by this design. Let the Research Engineers of G-B study your problems.

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Design changes

from page 154

solution. Droplets of emulsion act as reservoirs for fresh monomers; polymerization is initiated in micelles of soap molecules which solubilize the monomers. Once started, polymerization continues in polymer particles swollen by monomer. The initiator, containing a free radical, is defined as a chemical fragment having an unpaired electron. These free radicals start the chain reaction in which the free electron is passed down the chain so that more fragments are joined together to form a long polymer molecule.

A modifier is added which curbs the length of the chain and which reacts with the chain to satisfy the free radical. In turn, it converts itself into a free radical which can start another chain. "Shortstops," which destroy free radicals, are added at the desired conversion point to stop the reaction by preventing further polymerization. A low reaction temperature improves the tensile strength, modulus, and other physical properties of the product rubber.

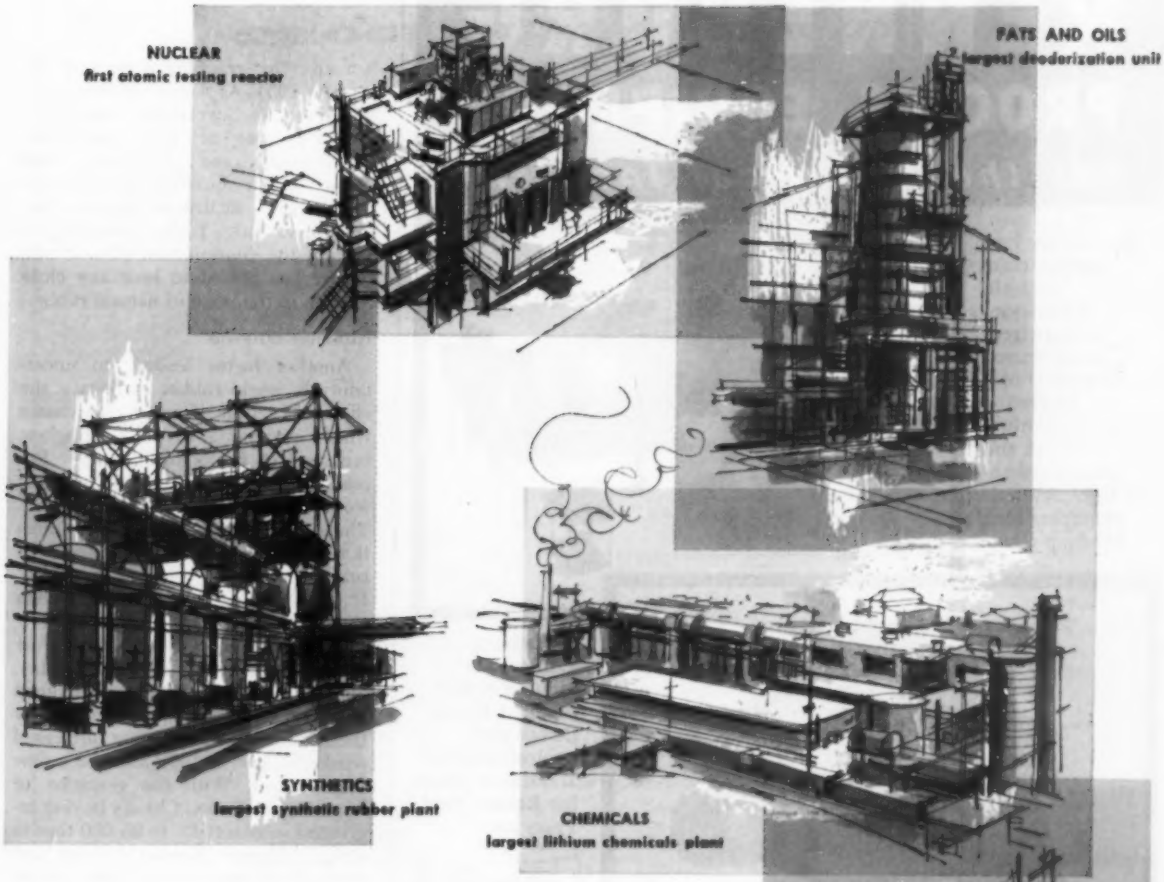
Four tanks

In the Louisville plant, four 7,500 gallon blow-down tanks serve to receive the unstripped latex from the reactors prior to its transfer to the recovery area.

A new stripping colum in the recovery section, said to be the largest of its type, is designed for a throughput of more than 100 gal./min. Polishing of the steel trays in this tower is claimed to effect great savings in downtime for cleaning by minimizing build-up of rubber on the surfaces.

In the stripping tower, the styrene is flashed off from the latex and the overhead is fed to four vertical single-pass condensers. The new vertical design of these condensers does not allow the rubber to build up in the head and around the tubes, and the straight-through flow permits easy rodding of the tubes for cleaning. The styrene, with its mixture of condensate, is separated from the water in a decanter and returned to storage.

The butadiene is flashed off in a series of vacuum and pressure tanks, compressed, condensed, and piped to recycle storage tanks in the tank farm. A vent gas system recovers butadiene which might otherwise be lost to the atmosphere during intermittent release of non-condensable impurities. #



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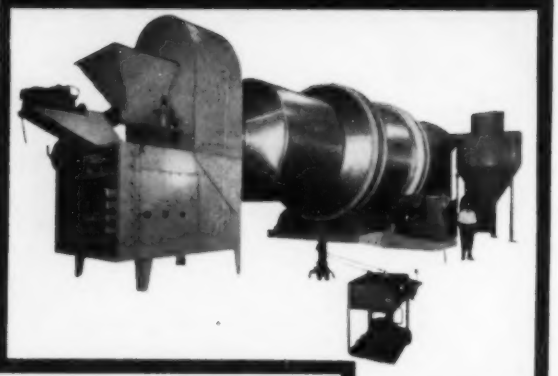
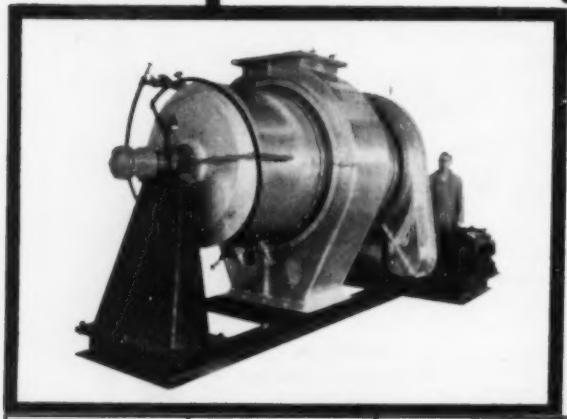
PROCESS EQUIPMENT
for the Chemical Industry

Renneburg low temperature, variable inclination, rubber-tired, steam-heated DehydrO-Mat Dryer for ammonium nitrates and other hard-to-dry chemicals requiring long hold-up times.





Renneburg stainless steel rotating steam-jacketed Batch Dryer with explosion-proof aluminum jacket for Rocket Fuel Program.

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Rubber meeting

from page 154

Korean War, reaching a peak of 85 cents in 1951. As a result of this crisis, the American Government authorized the re-opening of their "moth-ball' GR-S plants, and plans were laid down for the building of synthetic rubber plants in Britain, France, Germany, and Italy. Today, according to Pickett, the consumption of synthetic rubber has ceased to bear any close relation to the price of natural rubber.

Russian enigma

Another factor leading to uncertainty in world rubber markets is the effect of Iron Curtain purchases which, according to H. C. Bugbee, president of the Natural Rubber Bureau, account for about 15% of total world production of natural rubber. There is, said Bugbee, a clear indication that substantial interchanges of rubber take place between the U.S.S.R., Red China, and the European satellites.

Red China entered the Korean War toward the end of 1950, and in May, 1951, the United Nations embargoed all shipments to China. Immediately thereafter, Russian buying increased markedly, and in 1952 attained a new high record. With the cessation of hostilities in Korea, China's buying increased substantially to 95,000 tons in 1956, whereas Russian buying had tapered off to a total of only 25,000 tons for the two-year period 1954-55.

In the field of synthetic rubber, the position in the Communist countries is also somewhat obscure. According to Pickett, an output of 462,000 tons is expected for 1958, which may rise to 650,000 tons by 1960. Out of a total of 20 plants in Eastern Europe, there are known to be 4 plants producing neoprene, and there is a considerable output of nitrile rubber. The Russians are also producing a synthetic polyisoprene, which has been tested extensively in tires.

Turning to the situation in the United States, O. V. Tracy, president of the Enjay Co., was confident that the present overcapacity will be completely absorbed by 1965. His estimate of total world production at that time coincides with that of Pickett, that is to say, about 4 million tons, including both natural and synthetic rubber. He looks for no sharp increase in supplies of natural rubber which, for 1965, he estimates at 2 million tons (present production 1.9 million); almost the whole increase will come

continued on page 160

PROCESS SIMULATION

Where is it used?

In Research Studies—Process Simulation:

- Bridges the gap between empirical data and theoretical expressions.
- Accelerates the determination of the effect of possible parameter variations.
- Quickly defines missing data required for completion of the study.
- Provides quick and convenient evaluation of theoretical equations.

In Process Design—Process Simulation:

- Permits rapid selection of the best of several design concepts.
- Provides faster optimization of proposed design parameters.
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- Facilitates more accurate scale-up of available pilot-plant data.
- Permits specifications of operating conditions for new designs that are closer to the safe, reasonable limits of the design.
- Applications include distillation columns, absorption beds, continuous reactors, catalytic reactors, heat exchangers, and many others.

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- Is especially effective in the accurate representation of instrumentation systems to facilitate integration of control elements.
- Provides special advantages in studying multi-loop and unusual control systems.
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The observations recorded are not guesswork. They represent the results of many hours of experimentation and study acquired by engineering groups of leading companies in the Chemical, Petro-Chemical, and Petroleum fields. These studies have been performed either on their own equipment or on analog computing equipment rented at any of EAI's completely staffed and equipped computation Centers in Princeton, New Jersey; Los Angeles, California; or Brussels, Belgium.

PROCESS SIMULATION

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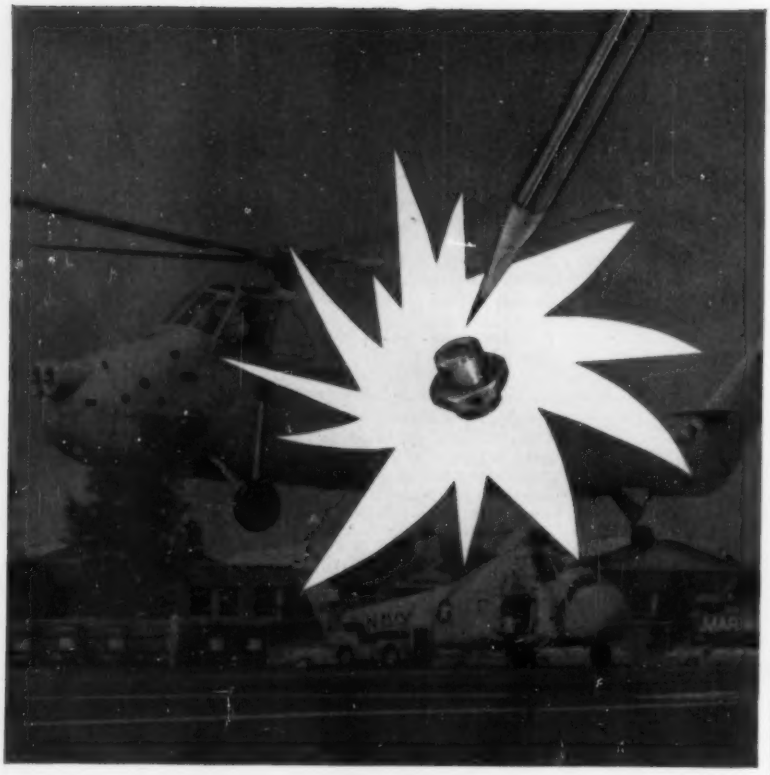

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At the heart of General Electric's new T58 turboshaft engine — a revolutionary new power plant for helicopters that packs over 1,000 horsepower into a 59" long, 16" diameter, 325 pound frame — are 16 precision built steel spray nozzles.

These are special nozzles, developed for the engine by Spraco engineers. Their critical function: to feed just-right amounts of fuel into the combustion chamber.

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SPRACO

Rubber meeting

from page 158

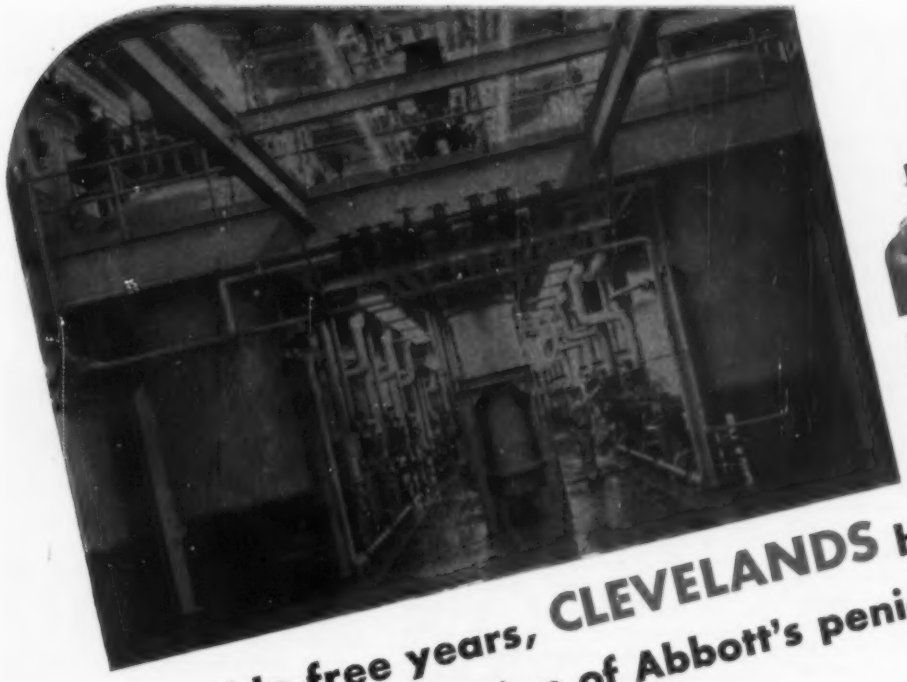
from new synthetic plants here and abroad.

New paths ahead

Quite apart from the question of raw materials for rubber manufacture, the development of synthetic rubbers has played an indirect part in other industries, emphasized Tracy. For example the copolymers of butadiene and styrene used in GR-S, when used in different proportions, have provided the widely-used water emulsion paints. Annual consumption of these coatings is now about 40 million gallons per year. The paper industry has developed new products through the incorporation of latices in paper products, and also by the incorporation of rubber latex in the coatings applied to highly-finished and specialty papers. Textiles have found new applications for synthetic rubbers in both fabric and thread.

In Europe, much interest is currently being shown in the field of resin-rubber blends and copolymers. A good example is the high styrene-butadiene copolymers increasingly used as a replacement for leather in shoe soling. Attention is also being focused on rigid rubber-modified resins, chiefly developed in the U.S. Another American development, styrene - butadiene - acrylonitrile copolymer blends, has been taken up widely in Europe, said Pickett, and they are now being made by Farbenfabricken Bayer in Germany. Their use is envisaged in hot water pipes, as well as in a variety of high-strength moldings. A most interesting possibility is offered by rubber-like ethylene-propylene copolymers, described recently by Natta of the University of Milan. #

An integrated synthetic rubber plant will be built in the vicinity of Yokkaichi, Japan, by the Japanese Synthetic Rubber Co., Ltd. This company was recently organized for the purpose of establishing a synthetic rubber industry in Japan. The first unit will be a Houdry Dehydrogenation Process unit to produce butadiene, principal ingredient in GR-S rubber. The Houdry unit will be designed to produce 25,000 short tons of butadiene a year, which, when supplemented by other butadiene sources, will produce 45,000 metric tons of synthetic rubber a year. #



5,000 gallon fermenter with Cleveland horizontal unit mounted above it. At left is the fermentation room, with battery of 12 steel tanks, at Abbott Laboratories, North Chicago, Illinois.

For 10 trouble-free years, CLEVELANDS have served in mass production of Abbott's penicillin

CONTINUOUS, uniform agitation of each batch is essential to proper processing of penicillin and other antibiotics. To insure uninterrupted, trouble-free operation at this leading pharmaceutical plant, Cleveland Worm Gear Speed Reducers were installed over ten years ago to drive the turbine impellers of a battery of 5,000 gallon fermenters.

In service continuously since 1946, these Cleveland drives have met every requirement. High yields have been the rule through the years. Only normal maintenance has been required. So far as life is concerned, the reducers are still "good as new".

Wherever trouble-free service and long life are a must in power transmission equipment, there your first choice is Cleveland. And there's a type and size for every need. Bulletin 145 shows the entire line of standard models, available when you need them. The Cleveland Worm and Gear Company, 3257 East 80th Street, Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers, Limited.

CLEVELAND
Worm Gear
Speed Reducers

New stationary furnace design may permit higher temperatures

Wider use of tonnage oxygen claimed possible by use of charge to insulate refractory furnace linings

GEORG A. ZOTOS

The upper temperature for modern thermal processing furnaces constructed of ordinary refractory materials is somewhere in the neighborhood of 3,600°F. New processes in the fluorine industry, in silicates, in thermochemical salt reactions, in advanced chemical metallurgy, in the alkali industry, and in many other applications await only an economical and practical method of utilizing much higher temperatures. Attemps at oxygen enrichment of combustion air have so far found only limited application, the main difficulty being excessive deterioration of refractory materials. There are some exceptions, however; in the steel industry, use of tonnage oxygen, now available at relatively low cost, is fast becoming standard procedure.

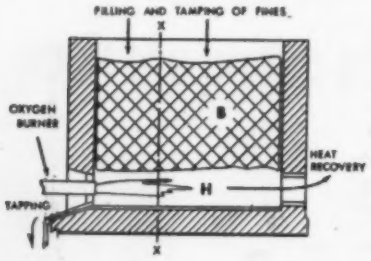


Figure 1

Enrichment of combustion air with pure oxygen is, moreover, open to objection on thermodynamic grounds. Once oxygen has been separated in a tonnage oxygen plant by consuming irreversible mechanical work, partial separation or dilution is obviously a retrograding operation.

Successful application in Germany of a new design glass furnace led the author to expand the principle incorporated in that furnace and to build what he believes to be the first furnace to operate on oxygen alone. The new conception consists in high-speed rotation of a relatively short cylindrical furnace body around a longitudinal horizontal axis. The centrifugal force vector developed at high-speed rotation overcomes the gravity vector; as a result, the molten charge in such a furnace has the shape of a hollow cylinder of great mechanical stability. Heating takes place in the cylindrical cavity formed by the liquid walls. Continuous operation can be maintained by charging at one end of the cylinder and discharging at the other. In effect, the rotating cylinder of molten charge acts to insulate the refractory walls of the furnace proper; the temperature gradient through the charge is sufficient to allow extremely high temperatures in the center of the cylinder without exceeding the permissible temperature at the furnace wall.

Early applications of this type of furnace were tested, starting in 1935, at the Zeiss optical work in Jena, Germany. Starting at initial temperatures of about 3,500°F, development work brought the temperatures up to 4,400°F within about eighteen months. The efficiency of this type of furnace can be increased by passing the superheated combustion gases through a chemical regenerator.

Large scale furnace design

The size of a rotating furnace is limited by dimensional factors. To overcome this limitation, a new type of furnace has been designed which retains the principle of the successful rotating type. The principle of the new design is illustrated by Figures 1 and 2. (Figure 2 is a cross-section view of Figure 1, at point x-x). The combustion chamber H is entirely surrounded by the material to be heated; this factor insulates all structural materials from the hot zone. Heat is supplied to the combustion chamber directly by an oxygen burner. B is a consumable block of the material to be treated; in practice, it is built up by pressing and tamping finely-divided charge material. Block B is maintained and controlled in a slow downward movement by a separate mechanism M. Coarse material is shunted to both of the side shafts S. These side shafts complete the configuration of the heating chamber by sloping down and covering the inside of the refractory brick structure, leaving a nearly triangular section free for passage of the combustion gases.

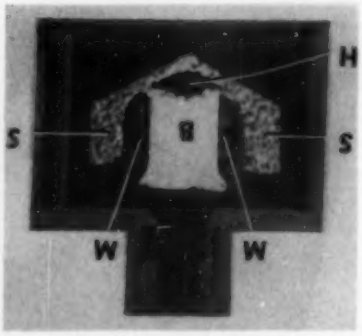


Figure 2

Start-up is accomplished by building up a bridge of auxiliary wood supports before firing starts. On firing, the supports burn out and the bottom of the block hardens. The block is then consumed as it moves slowly downward; the operation is then continuous.

This type of furnace has only been tested on a small pilot scale. Further development work will be necessary to prove out its overall performance in specific applications.

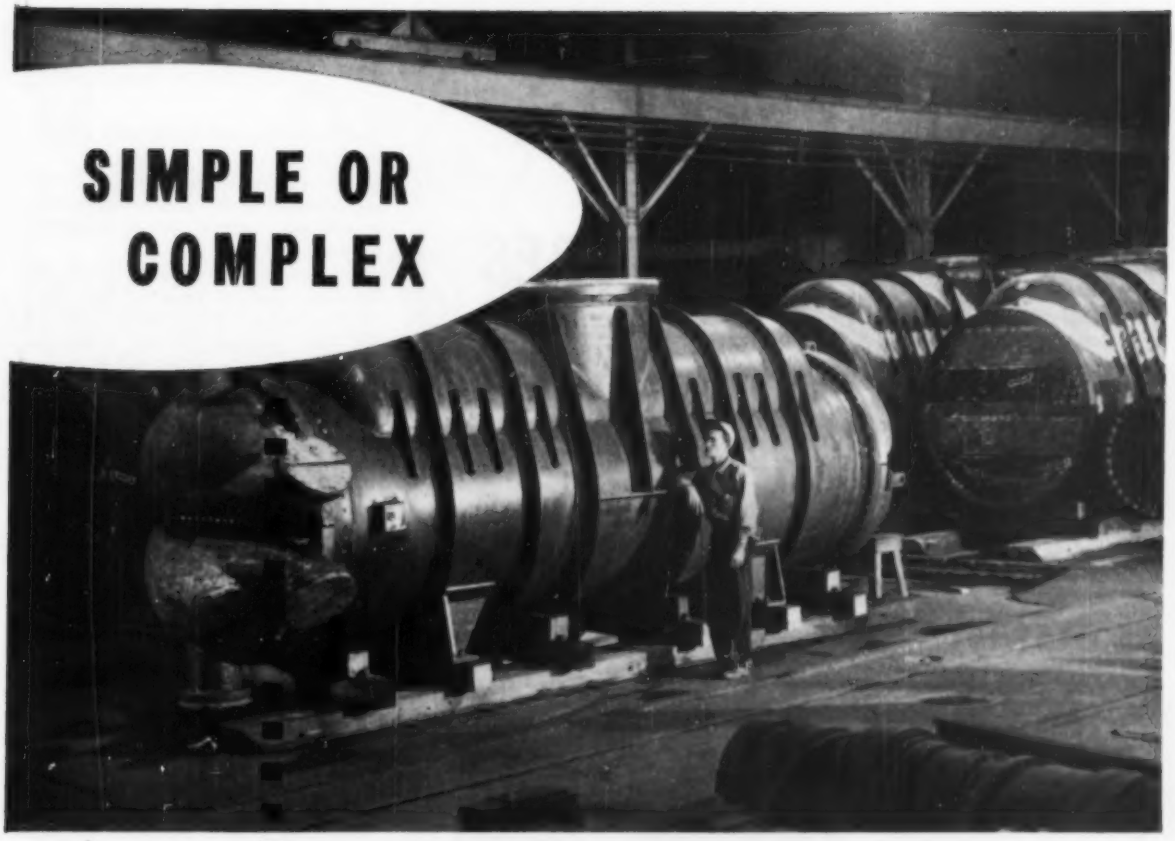
New catalyst system for ethylene polymers

Comprehensive details of new catalyst mechanism revealed by Bakelite, but the company emphasizes that the developments are still in the research stage, commercialization is some distance away.

Two technical papers by J. J. Smith and W. L. Carrick of Bakelite (Carbide) claim that investigation has shown a new body of information on how to produce high-density polyethylenes.

According to the original research involved, a system of tetraphenyl tin and aluminum bromide formed an efficient catalyst for low pressure ethylene polymerization. Importance of this discovery lies in the fact that vanadium compounds are an essential ingredient of the catalyst. Minute traces of vanadium bromide are normally present in commercial alumi-

continued on page 164



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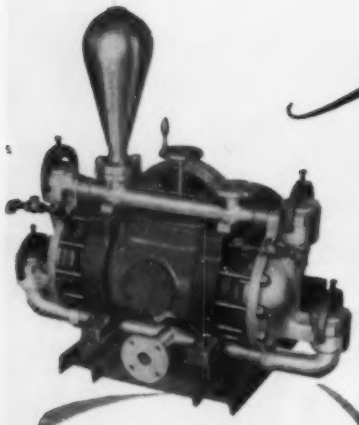

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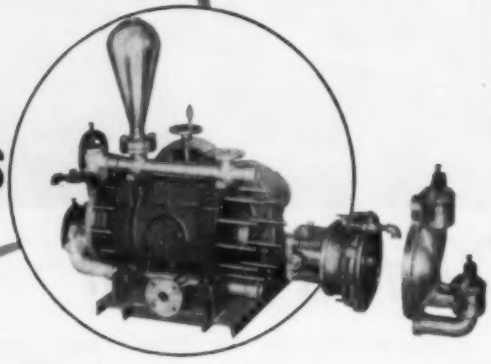

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Catalyst system

from page 162

num bromide, but are usually considered an impurity.

Also significant in the report is the statement that the catalyst system is completely soluble in hydrocarbon diluents.

The recently-developed catalyst, the Bakelite scientists reported, has been used to prepare laboratory samples of ethylene polymers. Tests conducted on these samples indicated that material produced this way possesses a linear molecular structure, high molecular weight, and narrow molecular weight distribution.

The report on the catalyst mechanism is acknowledged to be a comprehensive study not only of the vanadium halide system, but also of organometallic catalysts currently used in commercial polymerization processes. The research data emphasize the novelty of the vanadium function and the extremely small concentrations required for comparatively high product yield.

The ethylene polymers made in the laboratory with the new system are characterized structurally by: 1) *High molecular weight.* Number average molecular weights are generally greater than 65,000 and in some cases are as high as 125,000. For commercial high and low pressure polyethylene this number average molecular weight ranges from 5,000 to 30,000.

2) *Linearity.* Verified by very low concentration of methyl groups, that is, less than one methyl per 2,000 chain carbon atoms—as measured by infrared analysis. Further substantiated by crystalline melting point which approaches that reported for polymethylene, 137°C.

3) *Narrow molecular weight distribution.* Demonstrated by distribution curves as well as extraction tests. In the former, approximately 90 per cent of the polymer is in a relatively narrow band of molecular weights. In the latter, the papers reported, less than 0.3 per cent of low molecular weight waxy polymer could be extracted by boiling cyclohexane. In commercially available low pressure polymers, these extractables vary from 2 to 6 per cent indicating significant concentrations of low molecular weight waxy polymers and broader distribution.

The material is also characterized, the report stated, by a melt index generally lower than 0.05. This is in contrast with commercial high and low polyethylenes that have melt indices of 0.5 to 20.

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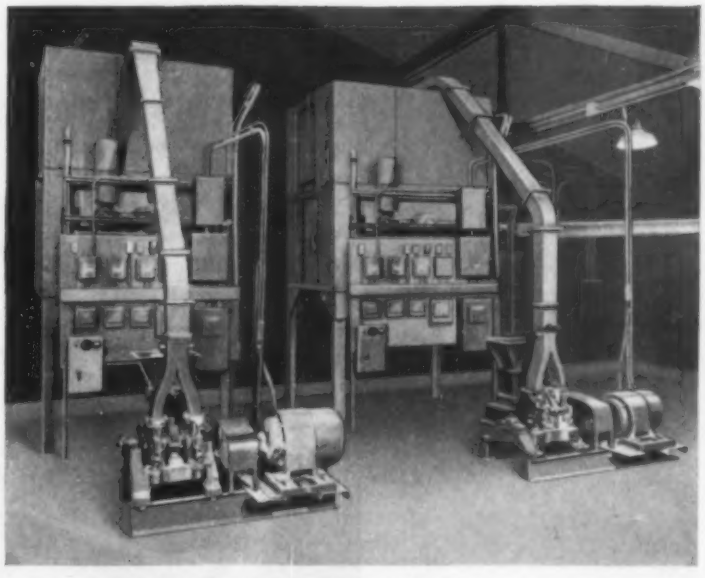

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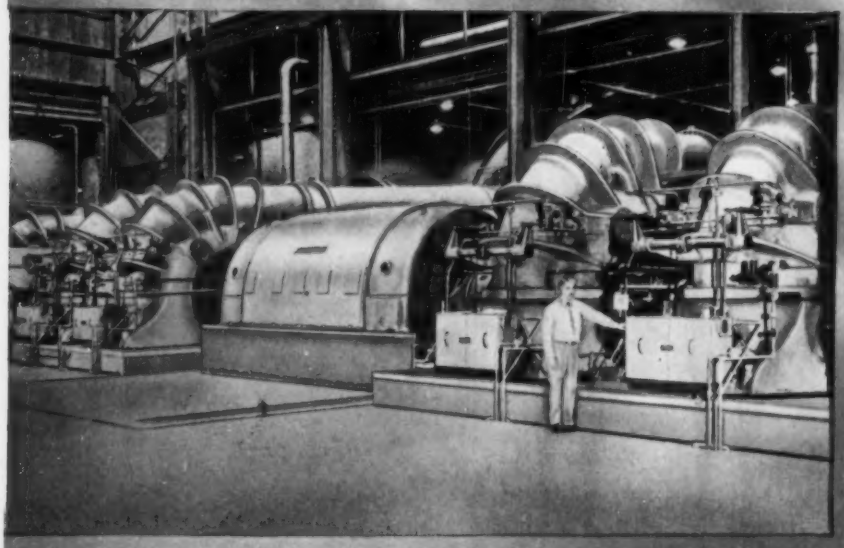
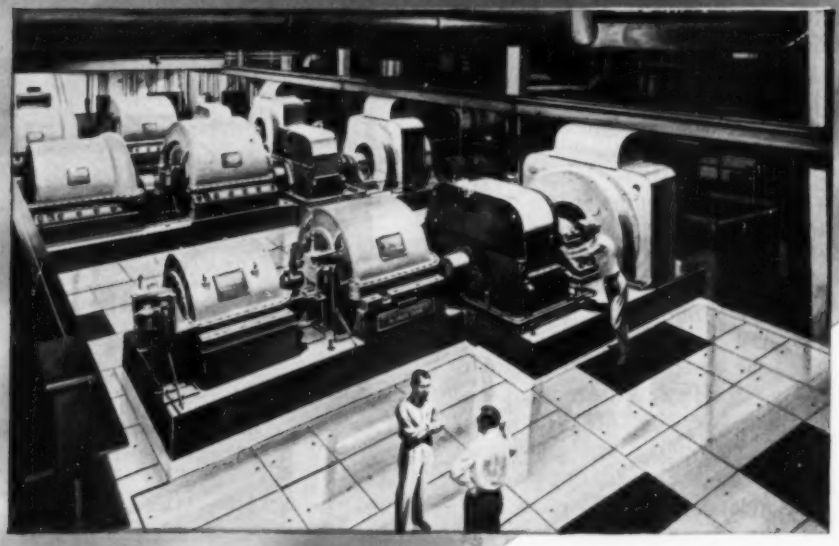


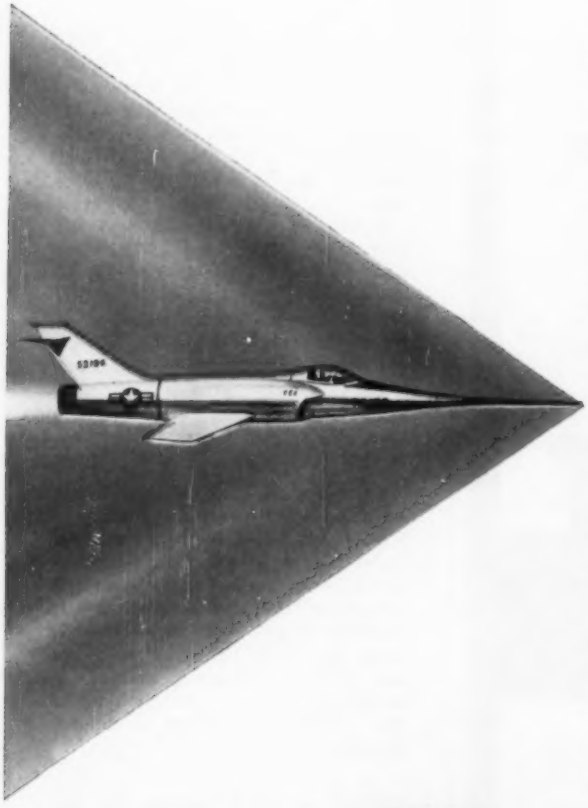
Five R-C single-stage centrifugal blowers developing over 1,000,000 cfm direct driven from electric motors rated at more than 80,000 HP at Langley Field, Virginia.

Six R-C multi-stage blowers rated over 75,000 cfm requiring about 14,000 HP, part of a centrifugal installation at Lewis Flight Propulsion Laboratory in Cleveland.



Roots-Connersville creates

STOP-AND-GO WHIRLWINDS FOR AIRCRAFT RESEARCH



Man-made air masses that match the violence of nature's hurricanes pour from the Roots-Connersville Blowers at the Lewis Flight Propulsion Laboratory of the National Advisory Committee for Aeronautics. Yet the power of these huge wind-making machines can be instantly controlled, from a soft, whispering breeze to a roaring, whirling cyclone. In the reverse, the siphoning air movement can develop almost perfect vacuums to simulate the air conditions of high altitudes. A similar but larger N.A.C.A. "wind-making system" is now completed at Langley Field, Virginia.

The same engineering and manufacturing abilities that developed these stop-and-go whirlwinds are applied by Roots-Connersville to the everyday movement of gas and air, in small or large quantities, for industry. Now in its second century of service, Roots-Connersville Blower Division, one of the Dresser Industries, builds the world's most extensive and varied line of such equipment.

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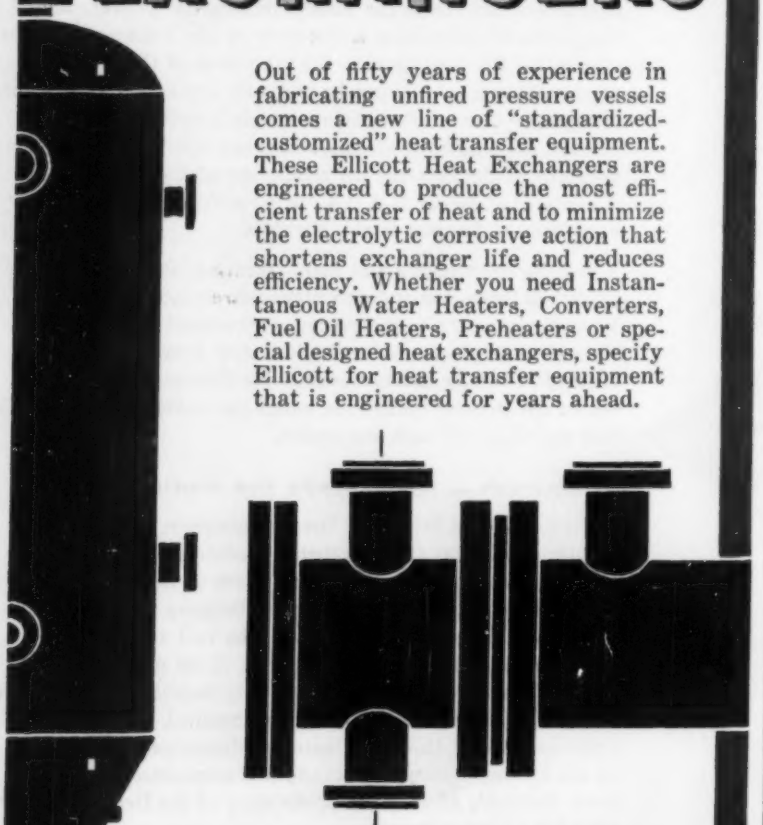

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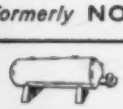
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institutional news

Modern Developments in Heat Transfer will be given as a special summer Course at MIT, July 8 through July 18, 1958. It is designed for teachers, research workers, and development engineers.

Another course will be Thermodynamics for Engineers and Chemists, to be given June 23 through July 3, 1958.

#

The Proceedings of the Third EUSEC Conference on Engineering Education, held in Paris in September, 1957, are now available from B. G. Robbins, The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London S.W. 1, England.

Available are: Proceedings of the Conference, 25 shillings ($3.25) for members of participating societies, 30 shillings ($4 20) for nonmembers; British Contribution to the Conference, 15 shillings ($2.10) and 20 shillings ($2.80); U. S. Contributions to the Conference, price not yet fixed; Belgian Contribution to the Conference, 25 Belgian francs.

#

An engineering seminar on automatic controls will be offered by Penn State Univ. August 3 to 8. The course is primarily for engineers and scientists whose work requires a broad understanding of the application of feedback control to industrial processes and product operations, as well as familiarity with modern techniques in the analysis and design of control systems.

Another suggested program for aid to basic research in American colleges comes from Esso Research and Engineering's Eger V. Murphree. His recommendations: Industry should progressively increase its support. Also, he developed three points for helping basic research in general. 1) More money to be given by government and industry to improve the quality of teaching of science and mathematics. 2) Development of more programs by government, industry and education to update high school teachers of science and mathematics. 3) Further study by government, industry and education of the educational needs of scientists and engineers, and planning to make courses of instruction more attractive.

#

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U.S.I. CHEMICAL NEWS

May ★ A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries ★ 1958

A.I.Ch.E. Marks 50 Years Of Progress This June

The American Institute of Chemical Engineers celebrates its Golden Jubilee this year. During the week of June 22, leaders of the American chemical industries, internationally-known figures in the chemical engineering field, and thousands of other members of the A.I.Ch.E. will gather at Philadelphia to attend technical sessions and the official banquet, and to witness the awarding of special achievement citations.

Since 1908, the American chemical process industries and the A.I.Ch.E. have grown together, helping each other advance into the present "Age of Chemistry." The A.I.Ch.E. has been a guiding force behind this progress. U.S.I. itself, founded in 1906 as a producer of industrial alcohol, could hardly have attained its present size and diversification without its chemical engineers and the organization behind them.

To quote the publisher of the Institute's official organ: "From the impressive plateau of its 50 years of progress, the American Institute of Chemical Engineers can look back with pride on a record of outstanding achievement, and forward with confidence to continued service to mankind."

New Lanolin Derivatives Soluble in Water, Alcohol

Polyoxyethylene derivatives of acetylated lanolin have been developed which are completely soluble in water, alcohol, and many oils and solvents. They yield persistent emollient films and have solubilizing properties desirable in cosmetics, pharmaceuticals, toiletries and aerosol formulations.

The materials are non-greasy, clear liquids designed to give a soft, non-tacky after-feel when incorporated into water and alcohol preparations and emulsions. They are produced in two forms: completely acetylated for applications where a high alcohol content is essential; and partially acetylated for aqueous and weak alcohol preparations. The higher the degree of acetylation the greater the hydrophobic and substantive characteristics of the material.

These new lanolin derivatives are suggested for aerosols, shave lotions and creams, hair tonics, rinses and shampoos, insect repellents and sunscreens, deodorants, anesthetics and antiseptics, among many other drug and cosmetic use possibilities.

Fluorinated Polyethylene Keeps Air and Gases Out, Odors and Flavors In

A recent patent claims that the addition of 0.03-3.5% by weight of fluorine to the surface of polyethylene films and bottles makes them substantially impermeable to atmospheric gases, perfume components, aromatic flavor constituents, and preserving or pressurizing gases. The properties of the polyethylene remain

MORE

SRE and Shippingport Reactor Mark Important "Firsts" in Atomic Power Program

SRE First Reactor to Supply Heat to Conventional Power Plant; Shippingport First Complete Commercial Atomic Power Plant

The Sodium Reactor Experiment in Southern California — first non-military nuclear reactor to feed heat into commercial power generating equipment for conversion to electricity — is a sodium-cooled, graphite-moderated experimental atomic power plant. Built for the Atomic Energy Commission, its purpose is to develop technical data for designing, constructing and operating full scale nuclear plants which will produce power economically.

In this reactor, liquid sodium metal in a closed system is circulated through the core, picking up reaction heat which it transfers to a second, non-radioactive closed sodium system. From this second system the heat is transferred to the power generation equipment of the Southern California Edison Company.

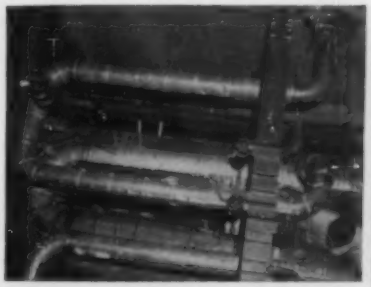
Sodium Coolant Has Advantages

Sodium makes an excellent reactor coolant because of its relatively low neutron-absorbing characteristics, good heat transfer properties, low melting point and high boiling point. High temperatures without high pressure can be produced when sodium is used as coolant.

As part of the experimental program, various fuel elements, components and structural assemblies are being studied in the SRE system. Right now the reactor uses uranium slightly enriched with uranium-235 in the core. Cores containing thorium-uranium alloys are planned for future investigation.

Shippingport Uses Zr, Hf, in Core

The new central-station atomic power plant at Shippingport, Pa. — first in this country to feed electricity into a commercial grid — contains in its core some 14 tons of uranium clad in zirconium metal and zirconium alloy, and control rods made of hafnium and zircaloy.



View of sodium-to-sodium heat exchanger which carries heat from SRE core to power generators. (photo courtesy Atomics International)

Zirconium metal has an extremely low nuclear cross-section — allowing free passage of neutrons — and makes an ideal cladding and supporting material for uranium because it offers minimum interference to the fission process, is corrosion and heat resistant, and structurally strong.

In the Shippingport reactor, the core is composed of 32 seed fuel elements containing about 165 pounds of highly enriched uranium clad with zircaloy. These seed elements are surrounded by 113 blanket fuel elements containing 14 tons of natural uranium clad with zirconium alloy.

Hafnium, although found closely associated with zirconium in nature, has the opposite type of cross-section characteristics. It absorbs neutrons readily, and consequently makes excellent control rod material. In the Shippingport reactor core, each of the 32 seed elements has its own two-part control rod. The absorber section is made of hafnium, the follower portion of zirconium alloy.

This pressurized water reactor plant started delivering electricity on December 18, 1957. It uses ordinary water to moderate the nuclear fission process, and the water under pressure is circulated through the reactor core to remove the heat. The hot water is pumped through heat exchangers to produce steam which in turn is used to power the generating turbines. The plant can deliver 60,000 kilowatts into the system of Duquesne Light.

At Shippingport during final stages of installation, reactor core is being lowered into pressure vessel. Zirconium-clad uranium fuel is contained in this core. (photo courtesy Westinghouse)

CONTINUED *Polyethylene*

unchanged.

This development should make it possible to package foods, colognes, other toiletries containing perfumes, aromatic solvents, mineral and vegetable oils and aerosol formulations in polyethylene films or flexible containers — without loss of volatile constituents or entry of deteriorating gases.

The fluorination process is claimed to be simple and economical. Film or bottles are washed free of lint, grease, dust and all foreign matter which might cause fluorine to ignite the polyethylene. After this, the film or container is contacted with pure fluorine or a fluorine-inert gas mixture, at room temperature or at up to 50°C. The length of contact varies depending upon the equipment, fluorine concentration, temperature and thickness of film or bottle.

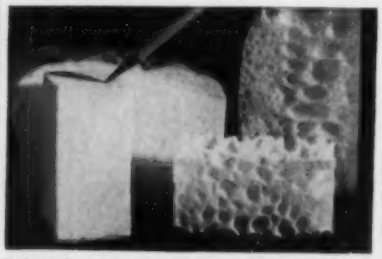
While clarity, flexibility, tensile strength, heat sealability and ultraviolet transmittal are claimed to remain unchanged, permeability of the polyethylene is decreased many fold. In a typical test with a volatile liquid, 5.6% of allyl caproate was lost from an untreated polyethylene bottle in 40 days. Only 0.05% was lost from a bottle which had received a six-hour fluorine treatment. Testing for oxygen transfer, an untreated film transmitted 303 cc per 100 square inches of surface in 24 hours. A treated film transmitted only 46 cc.

Silicone Additives Insure Uniform Cell Structure in Flexible Urethane Foams

Silicones are now being added to flexible polyurethane foams to give smaller, more even cell structure, uniform resilience and flexibility, and better appearance.

One type is a water-dispersible emulsion which can be added directly to the catalyst phase of the foam system. The manufacturer recommends that it be added as the last component when making up this phase, and claims that it will remain uniformly dispersed from several days to two weeks in most catalyst systems. Another type is a fluid added directly to the prepolymer and dispersed by thorough agitation.

Flexible polyurethane foams have evoked wide-spread interest as insulation for both industrial and consumer use, as cushioning, and for a variety of specialty applications. They can be produced from the reaction of polyesters with diisocyanates. An intermediate that can be used to produce the polyesters is U.S.I. ISOSEBACIC® Acid, a mixture of C-10 dibasic acids.



Polyurethane foam containing silicone additive has smaller, more uniform cell structure than other samples containing no silicone.

New Sterilizing Method Employs Ethylene Oxide in Safe Aerosol Formulation

The U. S. Department of Agriculture's Entomology Research Division reports that they have found a way to combine highly volatile ethylene oxide with ordinary aerosol propellants to form a non-flammable sterilizing formulation.

Ethylene oxide is a known germicide, insecticide and sterilant, but its highly flammable nature has been a deterrent to its widespread use for these applications.

The new aerosol is designed for sterilizing sensitive materials which cannot stand treatment by steam, dry heat or liquid chemicals.

TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U.S.I.

Radioactive isotopes and isotope-labeled compounds are described in a new price list now available. Included are C-14 compounds, heavy water, deuterium- and tritium-labeled compounds, N-15 compounds of high isotopic concentration. **No. 1350**

Fatty amines are discussed in new 24-page booklet covering method of manufacture, applications, chemical reactions, vapor pressure, solubility and handling. **No. 1351**

1723 Voluntary national standards approved by the American Standards Association are listed in free 67-page index just published. Standards in fields of chemicals, petroleum, rubber, textiles, are included among others. **No. 1352**

Sodium dispersions which improve chemical reaction efficiencies by providing more active surface area are described in 42-page booklet. Latest production equipment for continuous preparation of dispersions covered. **No. 1353**

Paper-strip electrophoresis analysis of various proteins, hemoglobins, amino acids and many organic and inorganic mixtures is outlined in a new catalog describing equipment for the purpose. **No. 1354**

New organic phosphate insecticide (O,O-diethyl S-p-chlorophenyl-thiomethyl phosphorodithicate) is claimed non-systemic, long-residual, less hazardous than many other organic phosphates. For control of mites and broad range of other insects. **No. 1355**

Plastic pipe for safe transportation of drinking water is discussed in new 12-page folder. Includes types of plastics used, method of joining lengths, suitable applications, standards set by Natl. Sanitation Foundation. **No. 1356**

Chemical analysis of solid surfaces by nuclear methods is described in 33-page U. S. Army report which can now be purchased. Methods used to detect all elements to depth of several microns (sensitivities from 10^{8}-10^{16} gm/cm²). **No. 1357**

Dangerous properties of over 8,500 chemicals, and safe practices in handling, storing and shipping, are outlined in a 1476-page book just put on sale. Toxicity, fire, radiation, air pollution, explosion hazards are covered. **No. 1358**

Tritiated thymidine is now offered in research quantities as a new tool for studies of growth. Material is said to be suitable for investigating cell formation and turnover, genetic patterns, effects of intracellular radiation and growth inhibition in neoplasms. **No. 1359**

PRODUCTS OF U.S.I.

HEAVY CHEMICALS

Sodium, Metallic: cast solid in tank cars, steel drums, pails; bricks in barrels, pails.

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Ammonia, Anhydrous: commercial & refrigeration. Tank cars or tank wagons.

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Pharmaceutical Products: DL-Methionine, N-Acetyl-DL-Methionine, Urethan USP, Riboflavin USP, Intermediates.

Alcohols: Ethyl (pure and all denatured formulas); Proprietary Denatured Alcohol Solvents SOLOX®, FILMEX®, ANSOL® M, ANSOL PR.

Organic Solvents and Intermediates: Normal Butyl Alcohol, Amyl Alcohol, Fusel Oil, Ethyl Acetate, Normal Butyl Acetate, Diethyl Carbonate, DIATOL®, Diethyl Oxalate, Ethyl Ether, Acetone, Acetoacetanilide, Acetoacet-Ortho-Chloranilide, Acetoacet-Ortho-Toluidide, Ethyl Acetoacetate, Ethyl Benzoylacetate, Ethyl Chloroformate, Ethylene, Ethyl Sodium Oxalacetate, Sodium Ethylate, ISOSEBACIC® Acid, Sebacic Acid, Urethan U.S.P. (Ethyl Carbamate), Riboflavin U.S.P., Pelargonic Acid, and 2-Ethyl Heptanoic Acid.

Animal Feed Products: Antibiotic Feed Supplements, BHT Products (Antioxidant), Calcium Pantothenate, Choline Chloride, CURBAY B-G®, Special Liquid CURBAY, VACATONE®, Menadione (Vitamin K_3), DL-Methionine, MOREA® Premix, Niacin USP, Riboflavin Products, Special Mixes, U.S.I. Permadry, Vitamin B_{12} Feed Supplements, Vitamin D_3, Vitamin E Products, Vitamin E and BHT Products.

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corporation
99 Park Avenue, New York 16, N. Y.

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Molecular Sieves Cage Catalysts

Molecular sieve materials made by Linde Co. Division of Union Carbide are being used to "cage" volatile catalysts such as the liquid catalyst produced by Carbide's Silicones Division to cure vinyl silicone rubber.

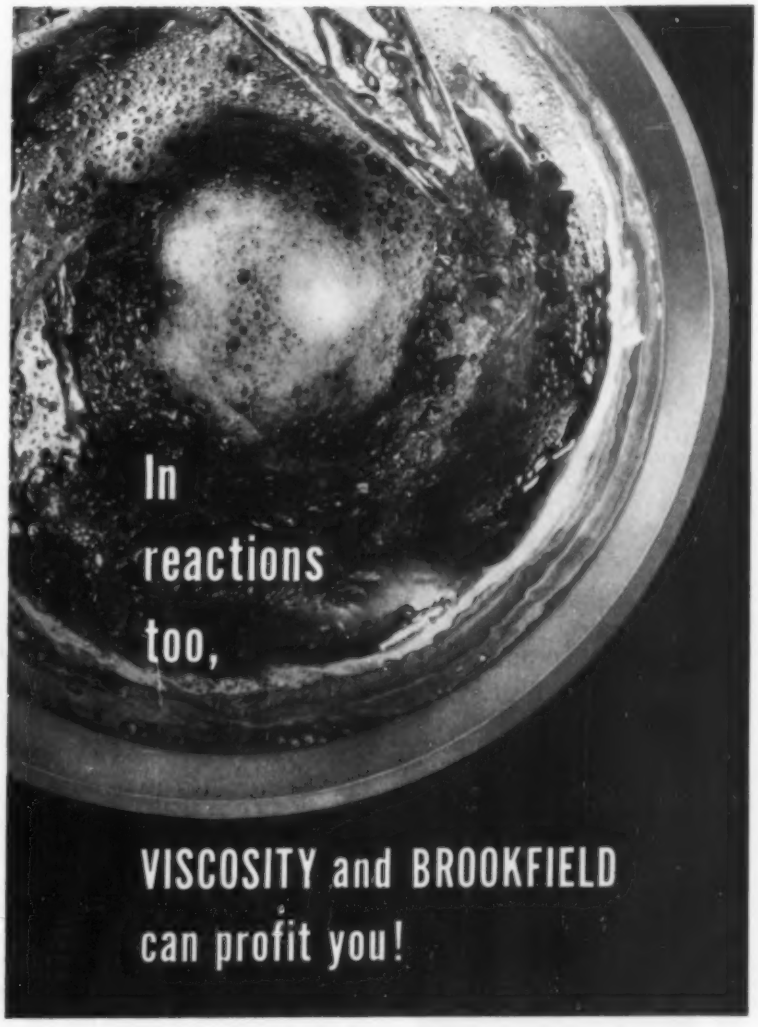
In their first commercial use as a carrier of volatile catalysts, Linde's molecular sieves were used to hold and contain Carbide's Silicone Division's di-tertiary-butyl-peroxide, the catalyst which gave optimum properties to compounds made from vinyl-containing gums.

It was well known by the Silicones Division that this material was the best catalyst for the purpose, but it was a volatile liquid which presented a safety hazard and evaporated much too quickly. By "caging" it in a molecular sieve, the Silicone Division produced a white paste which was safe, easily handled, and released the catalyst whenever needed in the process.

Linde's molecular sieves are man-made adsorptive crystals, chemically similar to clays and feldspars, and belonging to a class of minerals known as zeolites. The outstanding property of these sieves is their ability to undergo dehydration without a change in their crystal structure. This leaves dehydrated crystals with regularly spaced channels of molecular dimensions comprising some 50 percent of the total volume.

These empty cavities have such a strong tendency to recapture the water that they will accept any material they can get if water is not present. The more polar the molecule of the material they accept, the stronger it will be held within the crystal. But these adsorbed molecules can easily be released by the application of heat or by displacement with a more strongly adsorbed material.

Since di-tertiary-butyl-peroxide is highly polar, it can be held safely in the molecular sieves without evaporation even with a long stay on the shelf, and can be released to act as a catalyst by the application of heat. #



It's true. In-process viscosity measurement is the most direct progress report of many chemical reactions that you can obtain. In polymerization reactions, for example, Brookfield process-mounted Viscometran units eliminate the need for constant sampling, assure greater product uniformity and guard against run-away reactions.

Like color, pH and stability the *viscosity* of any material is a vital property, a fundamental measurement, which can be easily and accurately evaluated and controlled with low-investment Brookfield instrumentation.

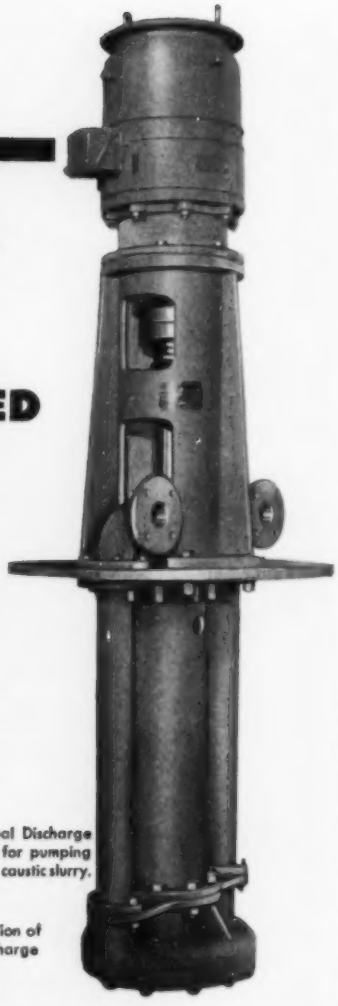
If you would like to know more about the profitable role of viscosity control in your processes, write today for complete technical information. There is no obligation.

THE WORLD'S STANDARD FOR VISCOSITY MEASUREMENT AND CONTROL

Brookfield

ENGINEERING LABORATORIES, INCORPORATED
STOUGHTON 18, MASSACHUSETTS

VERTICAL PUMPS WITH NO SUBMERGED BEARINGS FOR PUMPING ABRASIVE CORROSIVE SLURRIES



2" Dual Discharge Pump for pumping molten caustic slurry.

Cross section of Dual Discharge Pump.

This rugged type of service calls for advanced design: — extra heavy shaft, double-ported casing to equalize the side thrust of the impeller, and tough abrasion-corrosion resistant alloys. The dual discharge pump illustrated here incorporates these features and dispenses with bearings or packing below the cover plate where they would be in contact with the liquid.

Difficult pumping problems, particularly in the process industries, have been our specialty for ninety-one years. Perhaps we can be of help to you. Write us — no obligation.

Write for Bulletin 203-6 for complete summary of acid and chemical pump data.

LAWRENCE PUMPS INC.

371 MARKET STREET, LAWRENCE, MASS.

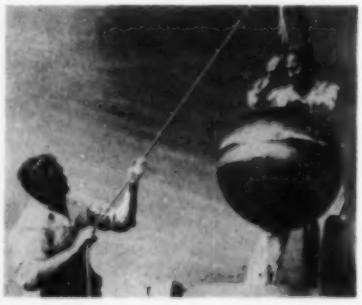
industrial news

The Separator Division of Southwestern Engineering Co. has moved into new and expanded facilities in Los Angeles. #

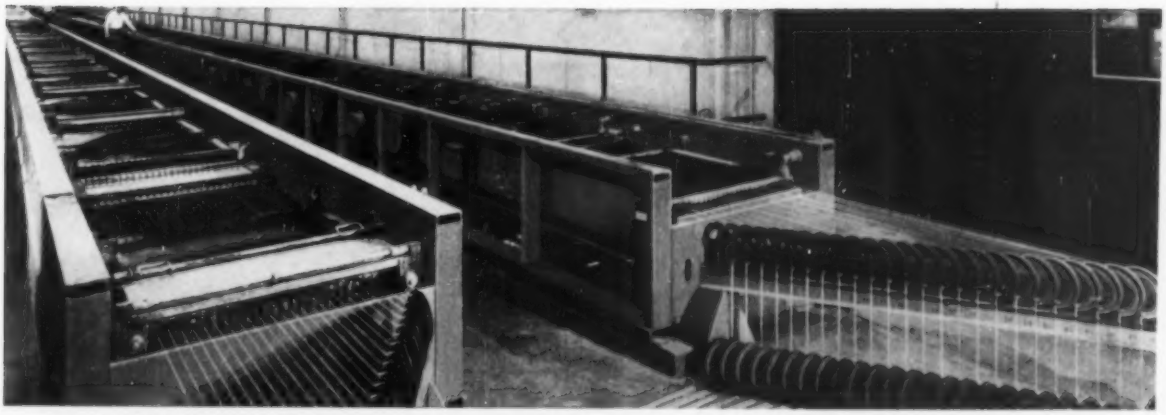
Barium oxide of 97-99 percent purity is now being manufactured in carlot and truckload quantities by Barium Reduction Corp. The company developed and perfected a process patented by Columbia-Southern Chemical Corp. to make the new, high-purity oxide. It is a fluid bed process, in which barium carbonate and carbon black are the starting materials, charged together with natural gas at relatively low temperature. Natural gas is used instead of the conventional electric arc used to make ordinary barium oxide. The resulting product is a white material in very small porous pellets, differing markedly from conventional barium oxide both physically and chemically.

Heyden Newport Chemical has sold its 50 percent interest in St. Maurice Chemicals, Ltd., of Canada, to the Shawinigan Water and Power Co. in exchange for 75,000 shares of Shawinigan common stock. St. Maurice manufactures formaldehyde, pentaerthyritol, and polypentaerthyritols. The plant was constructed with Heyden's technical help, and Heyden will continue to make its patents and technical knowledge available. #

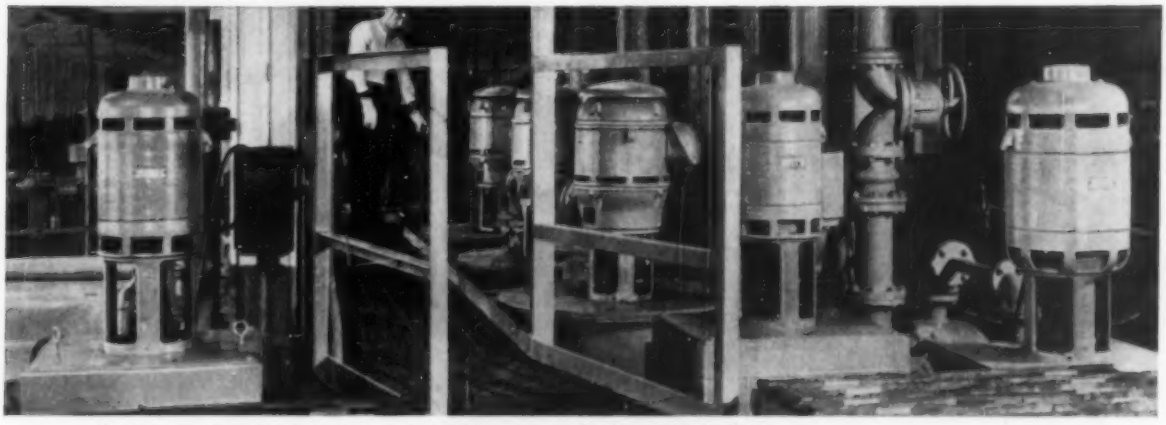
Construction of a plant to make Teflon 100-X, a new fluorocarbon resin which may be extruded and molded, is underway at Du Pont's Washington Works, Parkersburg, W. Va. Commercial production is expected by the middle of 1959. #



The first large-scale use of titanium in the ICBM program is in the giant Atlas Missile. The metal will be used in helium storage bottles such as this which help control propellant flow into combustion chambers in the missile. Titanium selection was based on four factors: weight savings, low temperature properties, strength, and corrosion resistance. #



For high product quality, solutions are constantly circulated through these tanks used to copper plate steel wire.



For low pump maintenance, parts contacting copper fluoborate electrolyte and 4 other corrosives are cast of nickel-containing stainless steels.

Cast stainless steels bolster life of pumps circulating copper fluoborate electrolyte

...brush off aggressive attack by this and 4 other corrosives

You can throw a lot of copper from a copper fluoborate solution.

But when pH is under 1 and the bath ranges up to 135°F, the corrosive capabilities of this electrolyte deserve respect.

Western Electric Company's Point Breeze Works protects important units with nickel-containing stainless steels. Take the vertical Aurora* pumps that circulate the fluoborate. Chromium-nickel stainless castings are specified for every part below the base plates . . . including support and discharge pipes. For studs and nuts, corresponding wrought grades of chromium-nickel stainless are called for.

Type CF-8M alloy castings are used for several 50-gpm pumps in filtering and solution handling. Type CN-7M alloy castings are employed in four 800-gpm units circulating electrolyte from tanks to cells.

CF-8M (20% Cr, 11% Ni, 2.5% Mo, 0.08% max. C) and CN-7M (29% Ni, 20% Cr, 3% Cu, 2% Mo, 0.07% max. C) are Alloy Casting Institute designations.

These nickel-containing cast stainless alloys are also used in pumps handling 4 other severe corrosives in the plating process . . . mixed alkalies at 190°F; 15% sulphuric acid at 90°F; hydrofluosilicic acid at 90°F; and lead fluosilicate at 150°F.

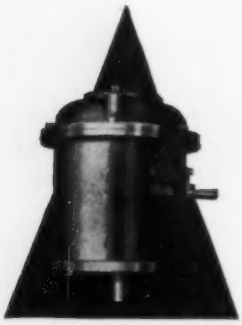
Chromium-nickel stainless steels exercise an effective restraint over corrosives like these. That's plainly shown in the Inco booklet, "Corrosion Resisting Properties of the Austenitic Chromium-Nickel Stainless Steels." Let us send you a copy.

*Aurora Pump Division of New York Air Brake Company, Aurora, Illinois.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street INCO New York 5, N.Y.

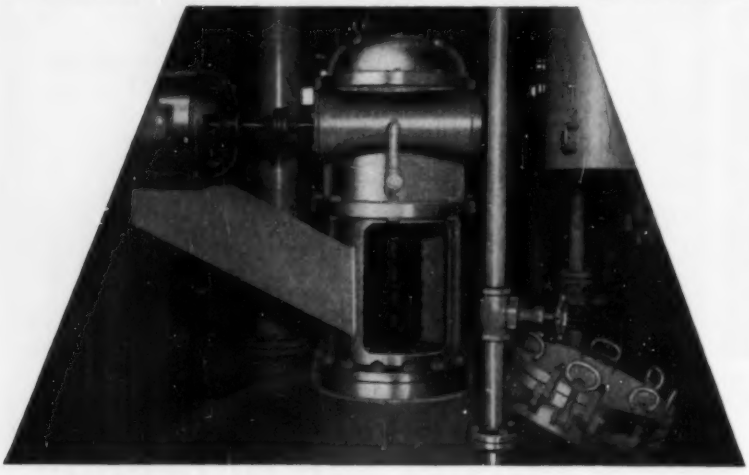
INCO NICKEL

NICKEL ALLOYS PERFORM BETTER LONGER



GET PRODUCT UNIFORMITY FASTER and at LESS COST

. . . with NETTCO Engineered Agitation!



INCREASE PRODUCTIVITY, lower power costs, and minimize maintenance requirements . . . with "process-rated" Model WT agitators by Nettco. Standardized components (motor, drive, shaft, stirrer) can be combined to suit your most exacting size, speed, HP or other process specifications. Check the design features of the Model WT tank top agitator . . .

- Worm gear reduction drives
- Ratios from 3.5:1 to 68:1
- Seven sizes available
- Complete range of speeds
- Minimum moving parts
- Large diameter vertical shaft
- Widely spaced, oversized Timken bearings
- Fully enclosed — dust, fume, moisture-proof
- Splash lubrication, drip-proof design
- Oil-trapped against leakage

Model T units, featuring helical gear trains and worm gears in combination, offer ratios from 6.25:1 to 100:1 in numerous "process-rated" models designed for dependable, economical operation. Ask Nettco agitation engineers for recommendations. Request Bulletin 551 and data sheet from **New England Tank & Tower Company, 92 Tileston Street, Everett 49, Mass.**

NETTCO
ENGINEERED AGITATION

FREE LITERATURE

Please send me the following literature:

- ☐ Tank Top Agitators—Bulletin 551
- ☐ Portable & Tripod Mixers—Spec. Sheets
- ☐ Pipeline-Flomix®—Bulletin 531
- ☐ Side Entering—Bulletin 532

industrial news

A major unit for carbon tetrachloride production has been brought on stream by Cornwall Chemicals Ltd. at Cornwall, Ontario. The company, jointly owned by Canadian Industries Ltd. and Stauffer Chemical, has been making carbon bisulfide since 1941. #

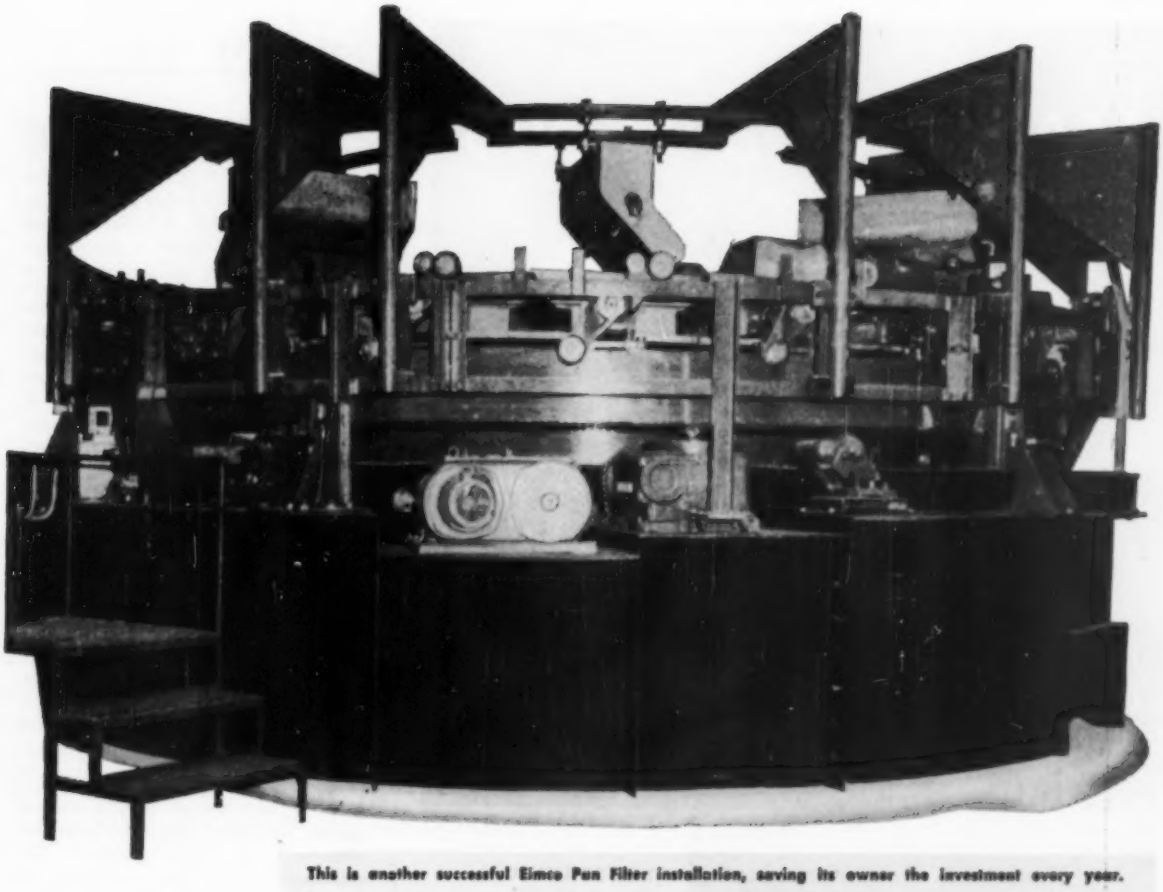
Nonylphenol prices have been reduced five cents a pound in the tankcar and tanktruck prices by Rohm & Haas. Drum and less-than-drum prices have been reduced 4½ cents a pound. New prices are: 19½ cents a pound for tankcar and tanktruck shipments; carload and truckload, 22 cents a pound; less than truckload, 23 cents a pound; and less than drum, 33 cents a pound. #

Anhydrous hydrogen chloride has been added to the product line of Frontier Chemical Co. New plant facilities have been built to meet an increased demand for the product. #

A new company, California Chemical International, Inc., has been formed to take over the expanding export market of Oronite Chemical Co. Like Oronite, the new company will be a subsidiary of Standard Oil Co. of California. Foreign sales of Oronite's petrochemicals have more than doubled in the last five years; now account for some 20 percent of the company's total volume, hence the need for a new company to handle operations in this sizable market. #

Products Tank Line of Canada, Ltd., a subsidiary of Union Tank Car Co., has purchased Sparling Tank and Mfg. Ltd. of Toronto. Sparling, a leading custom fabricator of shop and field-erected storage tanks, elevated storage tanks, piping, and other welded products, will operate as a division of Products Tank Line. #

A long-range program to develop and apply automatic techniques of information storage and retrieval to the exhaustive problems of patent search on chemical compounds has been underway for some time through the cooperation of the National Bureau of Standards and the U.S. Patent Office. At present, an estimated 60 percent of a patent examiner's time in processing a patent is spent in the necessary exhaustive literature search. With automatic machines, this time should be drastically reduced, materially speeding the processing of patents. #



This is another successful Eimco Pan Filter installation, saving its owner the investment every year.

EIMCO PAN TYPE FILTERS FOR ACCURATE WASH CONTROL

Eimco Pan Type Filters are essential for horizontal filter operation where:

1. Complete discharge is desired
2. Accurate wash control is recommended
3. Clean, washed filter media is required
4. High production is necessary
5. Quality product is a must

Each pan is essentially a filter unit in itself. Eimco designs provide for sizes from 20 to 500 square feet of filter area with custom features depending on the products to be filtered. Such items as feed stations, materials of construction, filter medium, wash stations, media washing and many other variations are supplied when customers process people meet with Eimco engineers to establish critical specifications.

Filtration problems are best solved by filtration specialists . . . Write Eimco.

THE EIMCO CORPORATION

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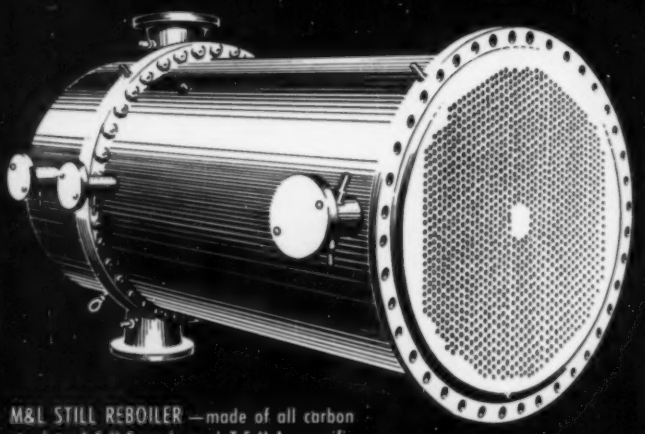
B-317

MANNING & LEWIS



M&L STILL REBOILER—made of all carbon steel to A.S.M.E. code and T.E.M.A. specifications. (Design temp. 450°F, weight 9500 lbs., Shell—44" dia., 8'9" length, 1-1/16" thick; 1500 steel tubes—¾" O.D. x 14 B.W.G.)

Many years of experience have given us an unusually thorough knowledge of the appropriateness, adaptability and qualities of fabrication of a wide variety of metals. This accumulated knowledge, coupled with our engineering experience and the important "extras" in fabrication, is your assurance of practical trouble-free equipment at the lowest possible cost.

It is impossible, in a field requiring such wide diversification, to illustrate, or even list all the products we have been called upon to supply. An excellent case in point, however, is the Reboiler above. In its fabrication, X-Raying was performed to assure perfect welds. This example is typical of the "extra" care you can expect and get from Manning & Lewis.

Call on us the next time you need equipment. We are fully qualified to design and fabricate to all codes.

M&L MANNING & LEWIS

ENGINEERING COMPANY

Dept. B, 28-42 Ogden Street, Newark, New Jersey

DESIGNERS & MANUFACTURERS OF QUALITY HEAT EXCHANGE EQUIPMENT

industrial news

All the assets of Yale & Towne's Tri-Rotor business have been sold to a new company, Tri-Rotor Inc. The new company will continue the manufacture and sale of these pumps which are widely used in the chemical and petroleum industries. #

Addition of facilities costing some $1.5 million will enable Davison's Bartow, Fla., triple superphosphate plant to produce run-of-pile triple superphosphate, a powder form, in addition to the regular granulated material. This additional process does not raise the over-all production of the W. R. Grace Division's plant, which is currently in excess of 200,000 tons annually. To obtain the new product, the strength of phosphoric acid produced there is raised by evaporation to more than 54 per cent P_2O_5 from the 39 per cent used for the granulated material. The higher strength acid is combined with ground phosphate rock in a TVA-type cone mixer and the resulting slurry is solidified on a setting belt, cured, milled and screened for shipment. #

A firm guarantee of 99.995 percent purity for argon gas has been announced by Linde Co. (Carbide). The new higher purity gas, containing less than 50 parts per million of impurities, is Linde's regular industrial argon. The guarantee is in the delivery state, not just the manfactured state, and no increase in price is involved. #

New facilities to produce propylene oxide and propylene glycol are under construction at Wyandotte Chemical. In addition, Wyandotte expects to have its ethylene oxide-glycol unit at Geismer, La., on stream very soon; and the company's new chlorine-caustic plant should be half completed and operating by the end of 1958. #

DuPont is reducing the price on two grades of ductile titanium metal sponge. The A-1 grade will drop from $2.25 to $2.05 a pound, and the A-2 grade will drop from $2.00 to $1.85 a pound. #

Special equipment for mixing solid rocket and missile fuels is now ready to go into full-scale production at the Chemical Machinery Division of Baker Perkins, Inc. #

A further expansion of Pennsalt's hydrofluoric acid facilities at Calvert City, Ky., will cost several million dollars, is already underway, will be completed in July. #

BAKER PERKINS MIXERS duplicate laboratory results on a production scale at WILLIAMSON ADHESIVES, INC.

Williamson Adhesives, Inc., of Skokie, Ill., are engaged in custom compounding of a wide variety of pre-mix molding materials for sale to the compression molding industry. To insure duplication of pilot results, Williamson uses Baker Perkins Mixers in both laboratory and production operations. A small 2.25 gallon Baker Perkins batch mixer is used in the laboratory for making test runs and developing new products, while a 100 gallon B-P mixer is used for actual production. As the small unit is identical in design and function to the large mixer, Williamson chemists can follow their manufacturing processes from the pilot plant stage to full scale production and maintain the same standard of quality.

The versatile B-P 100 gallon mixer can handle 500 pound loads of widely dissimilar materials; soft doughs, plastics, heavy viscous semi-liquids or dense, fibrous masses.
With the aid of careful temperature, moisture and operational controls possible with Baker Perkins equipment, Williamson is able to increase capacity, control quality and extend the range of materials which may be processed. The benefits gained with B-P Mixers at Williamson Adhesives, Inc., are proof that BAKER PERKINS Mixers are best. If you have a mixing problem, a Baker Perkins Sales Engineer is a good man to call in.

See our insert in Chemical Engineering Catalog for additional information.

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BAKER PERKINS INC.

CHEMICAL MACHINERY DIVISION • SAGINAW, MICHIGAN

Dimethyl sulfide production from kraft pulp mill black liquor

W. G. Meyer and J. G. Coma
Crown Zellerbach Corporation
Camas, Washington

The kraft (or sulfate) wood-pulping process employs an aqueous solution containing sodium sulfide and sodium hydroxide. During the digesting operation about 50% of the wood charge goes into solution. The residual pulping solution, called "black liquor," is complex but essentially contains modified lignin and certain amounts of free alkali and sulfide.

Proper pulp mill operation produces black liquor containing 12 to 20% solids. Normally the solution is concentrated by evaporation until the solids content is 55 to 60%. Make-up chemicals, usually salt cake, are added and the material is sprayed into a furnace. Combustion produces a smelt of sodium carbonate and sodium sulfide. Energy is recovered by means of a boiler producing steam for various process uses. The smelt is dissolved and causticized to produce the kraft pulping solution termed "white liquor." During the pulping and recovery operations small amounts of methyl mercaptan and dimethyl sulfide are produced in quantities insufficient to make recovery economical. As such, these compounds merely contribute to the kraft mill odor problem.

Practical yields of D.M.S. from black liquor can be obtained by providing proper reactant concentrations and a temperature favoring maximum demethylation of lignin. A process designed to obtain D.M.S. in maximum yield from black liquor is in the final development stages at Crown Zellerbach Corporation laboratories in Camas. Such a process may not only increase the profitability of wood usage but may also provide D.M.S. at a cost favorable to accelerated use of this chemical in industry. Since methyl groups are removed from the lignin compounds, it is possible that less CH_3SH will form in later pulp mill recovery operations and minimize the odor problem.

Original process work at Crown was based on a procedure described by Hagglund and Enkvist in Sweden (*1*). In this process sodium sulfide is added to concentrated black liquor. The mixture is then heated to 570° F. and held for several hours. D.M.S. is recovered by flashing and condensation. Some CH_3SH is produced. Originally, this was to be converted to D.M.S. by vapor phase catalytic reaction with H_2S at 660° F. Total D.M.S. yield this way is about 65 lb./ton of wood pulp produced.

It was found at Crown that by certain process modifications, D.M.S. could be obtained in comparable yields at lower temperatures and shorter hold times. Yields near 60 lb./ton of pulp were obtained in the 450 to 500° F range without catalytic conversion of mercaptan.

Pilot Plant

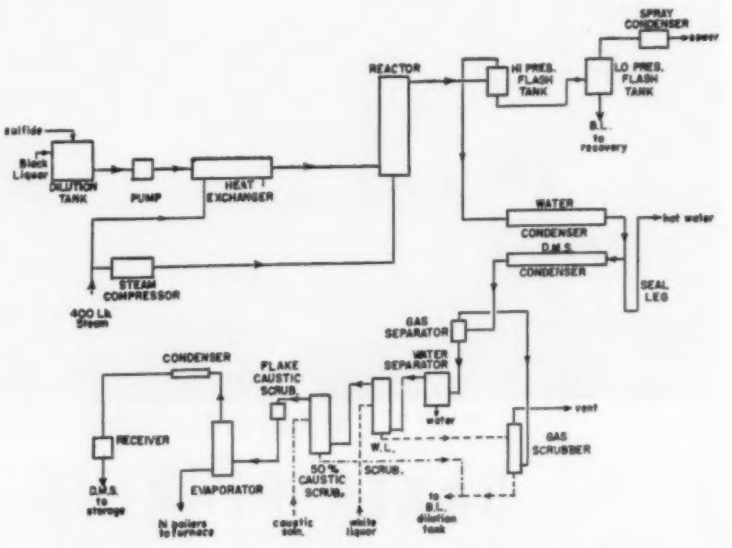
A pilot plant, designed to produce nearly 2,000,000 lb./yr. of D.M.S. based on the modified process, was erected near the kraft mill facilities at Camas. A side stream of black liquor from the multiple effect evaporators supplies the pilot plant.

The pilot plant flow diagram is shown here. Black liquor from the evaporators contains 50% solids. Sulfur compounds are added and a triplex-plunger pump meters the liquor at 200° F. into the heater-reactor system against a pressure of 600 lb./sq. in. Using 380 lb./sq. in. steam, a 420° F. liquor temperature is obtained by indirect heat exchange. The reaction temperature of 450-500° F. is reached by sparging additional steam directly into the black liquor. Since only 380 lb./sq. in. boiler pressure is available, this steam is introduced by means of a compressor.

The reactor is simply a pressure vessel through which plug flow occurs and time is allowed for obtaining maximum D.M.S. concentrations. Pressure control on the reactor discharge determines black liquor pump and steam compressor discharge pressures.

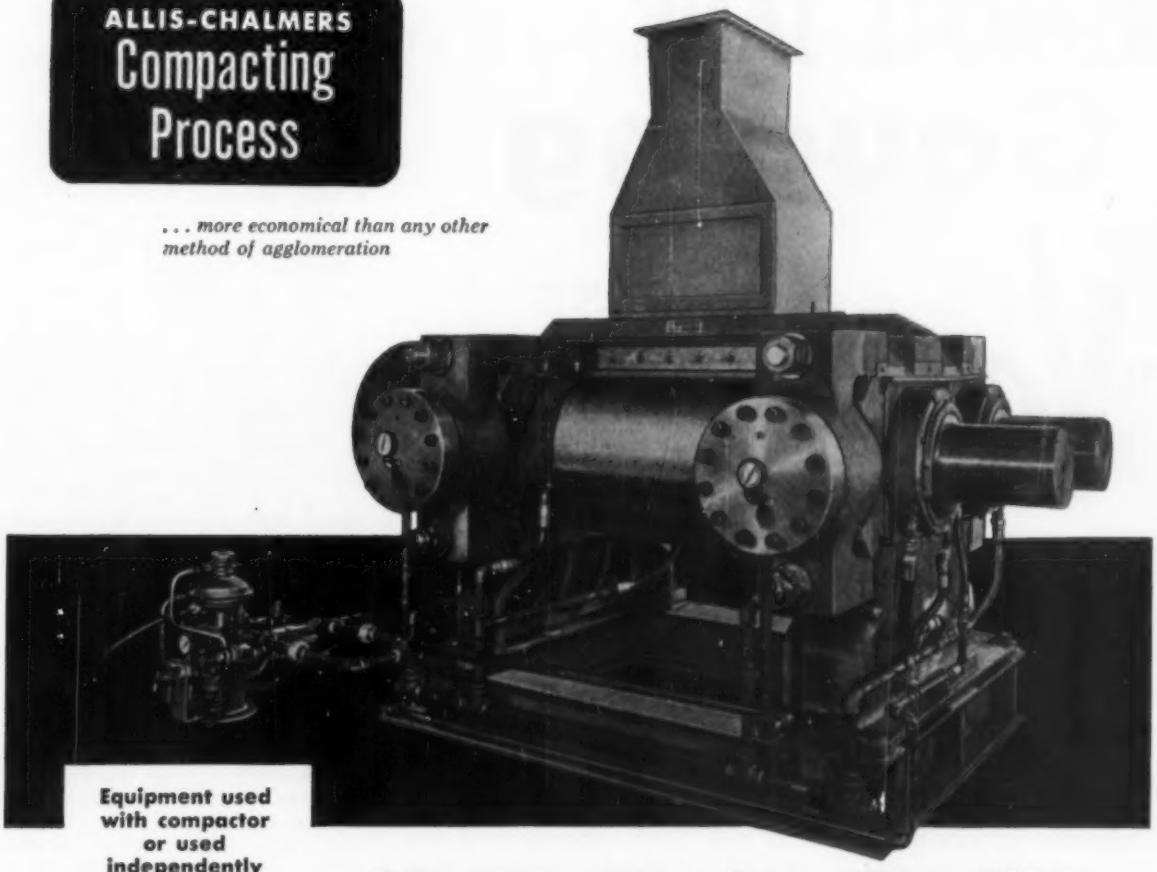
In a primary flash tank, temperature and pressure are reduced to the point where the bulk of the D.M.S. is in the vapor phase. The vapor phase is removed from the flash tank through a pressure regulating valve and the partially demethylated black liquor is removed by liquid level control. This black liquor is flashed to atmospheric pressure in a secondary tank and returned to the kraft recovery system. Steam from this flash tank is passed through a spray condenser mainly to minimize the odor

Continued on page 180

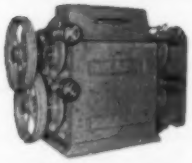


ALLIS-CHALMERS
Compacting Process

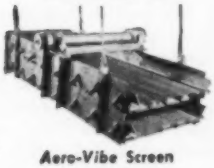
. . . more economical than any other method of agglomeration



Equipment used with compactor or used independently



Granulating Mill

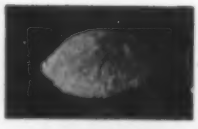


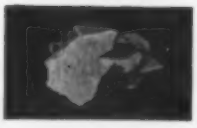
Aero-Vibe Screen

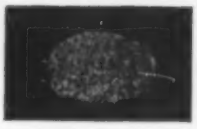
Gyratory Screen

Upgrade for Profits ...Mechanically

Precise control of *particle size, density* and *solubility factors* is now assured with the Allis-Chalmers compacting process. The heart of this efficient, completely mechanical system is this new Allis-Chalmers compacting mill.







Converts Loss into Profit

By-product material, too fine for use, from the original process, is first densified into slabs or flakes in the compacting mill. Agglomerated product is then granulated in the roller-type mill and separated in the vibrating or gyratory screen. This conversion of by-product material into a usable product changes loss into added profits.

Get Bulletin 07B8836 for the complete story. Ask your A-C representative for a copy, or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

Aero-Vibe is an Allis-Chalmers trademark.

A-5582

ALLIS-CHALMERS

REMOTE TANK Gauging

with

"Varec" PULSE CODE Telemetering

Receivers are available with horizontal "In-Line Indication"

1st *to offer a telemetering system that uses only ONE receiver and one communication channel to collect and display variable data transmitted from several different forms of measurement from several locations.*

CENTRALIZE the data at one Receiver from:

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Black liquor

from page 178

of the small amount of CH_3SH present. In a larger plant it might prove economical to recover heat from the flashing operations.

The vapors from the primary flash tank contain D.M.S., CH_3SH, organic polysulfides, H_2O, and inert gases (mainly CO_2). Much of the water is removed in a primary condenser as 160° F. condensate. It is desirable to remove as much of the water as possible at elevated temperatures to lessen D.M.S. solubility. The hot condensate flows to the sewer through a seal leg of dimensions consistent to the condenser operating pressure.

Vapors passing the primary condenser enter a second where crude D.M.S. is condensed and cooled several degrees below its 98° F. boiling point. Noncondensable gases are vented and passed through a scrubber to eliminate traces of CH_3SH. These gases contain some D.M.S. not removed in the gas scrubber. An adsorption system is being devised to recover this. The crude D.M.S. flows into a separator tank where two phases develop: a low density phase of about 85% D.M.S., 10% CH_3SH, 5% polysulfides, and traces of H_2O; and a high density phase—water containing some dissolved D.M.S. This water is sewered by means of phase interface level control. This control device uses the extreme difference in dielectric constant of the two liquids. Since much of the water is removed previously by high temperature condensation, D.M.S. losses with the water phase are not serious.

Crude D.M.S. overflows the separating tank and passes through a purification system by gravity. Kraft process white liquor is used in a packed extraction column to remove CH_3SH as sodium methyl mercaptide. White liquor is denser than, and immiscible with, dimethyl sulfide. Leaving the bottom of the extraction column, the white liquor passes through the noncondensable gas scrubber and is then added to the black liquor entering the process. Most of the sodium and sulfide content of the white liquor is thus eventually recovered in the kraft process.

Mercaptan-free D.M.S. overflows the white liquor scrubber into a caustic scrubber. Dissolved water is extracted from the D.M.S. as it passes up through a 50% caustic soda solution. Exhausted caustic solution is also added to the process black liquor for

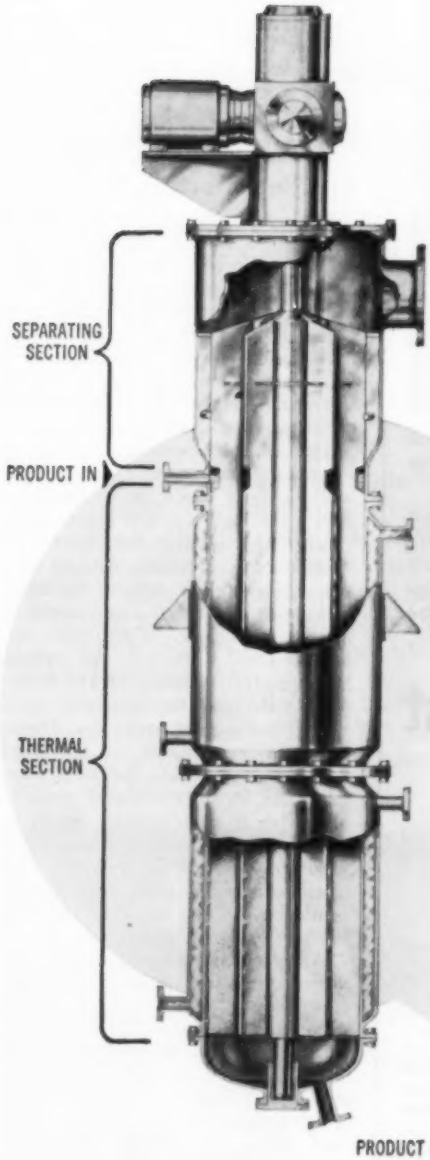
continued on page 182

Solve Difficult Liquid Processing Problems

with the New

RODNEY HUNT

TURBA-FILM®
MARK II
PROCESSOR



When viscous fluid processing is "bugged" by complex procedures, time-at-temperature-sensitive materials, sluggish control of product quality . . . look to the new Rodney Hunt Turba-Film Mark II Processor to simplify your problems.

Utilizing a turbulent thin-film technique, the patented Turba-Film Mark II Processor provides mechanically aided heat and mass transfer *in one pass, continuously and rapidly,* for a wide range of viscous fluids and slurries. It delivers controlled uniformity of product in

concentration . . . deodorization . . . dehydration . . . evaporation . . . heat transfer . . . reaction . . . stripping . . . and other processes.

Short-time exposure and minimum hold-up of the process fluid in the thermal section assures uniform heat and mass transfer, even at high temperature. Foaming is controlled by a mechanical separator and the formation of crust is minimized permitting continuous operation for long periods.

A large number of installations have proved conclusively the superiority of the Turba-Film Processor for processing chemicals, pharmaceuticals, lactices, solvents, foods and many other products.

An Invitation

Rodney Hunt will be happy to work with you in solving your process problems, utilizing its extensive engineering, laboratory and pilot plant facilities. Address your inquiry to the Rodney Hunt Process Equipment Division or write for Catalog 117, the story of the Turba-Film Processor.

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PROCESS EQUIPMENT DIVISION
37 VALE STREET, ORANGE, MASSACHUSETTS, U. S. A.

SERVING THE PROCESS INDUSTRIES WITH EQUIPMENT AND ENGINEERING

Centrifugally Cast Pipe is STRONG Pipe.....

Planning to install high pressure lines in your plant? Will they carry hot corrosive liquids or gases?

You will find SAFETY in DURASPUN Centrifugally Cast Pipe. It's very strong, with strength approaching that of forged steel. It can be alloyed to give you maximum resistance to the heat and corrosion to be encountered.

.it's alloyed to resist corrosion and high temperature

DURASPUN Pipe comes in a wide range, as follows:

Outside Diameter	Minimum Wall	Length
2½" to 3"	1/4"	88" maximum
3" to 6" Inclusive	5/16"	110" maximum
Over 6" to 12" Inclusive	3/8"	168" maximum, 24" minimum
Over 12" to 14" Inclusive	7/16"	168" maximum, 24" minimum
Over 14" to 20" Inclusive	1/2"	180" maximum, 48" minimum
Over 20" to 24" Inclusive	1/2"	88" maximum
Over 24" to 32" Inclusive	5/8"	80" maximum

This is standard piping. Special cylindrical shapes in comparable high alloy steel can be cast centrifugally . . . retorts, furnaces, fractionaters and other such equipment come in this class.

Write us about your requirements. Our metallurgists backed by thirty-five years of experience will be glad to help select the best combination of alloying elements to take care of your operating conditions.

THE DURALOY COMPANY

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EASTERN OFFICE: 12 East 41st Street, New York 17, N. Y.
DETROIT OFFICE: 23906 Woodward Avenue, Pleasant Ridge, Mich.
CHICAGO OFFICE: 332 South Michigan Avenue

Black liquor

from page 180

eventual sodium recovery. Final product dryness is obtained by passing the D.M.S. down through flake caustic soda. The solid caustic slowly dissolves forming a concentrated aqueous solution which flows along with the D.M.S. into the evaporator.

A simple still

The evaporator is a simple still in which pure D.M.S. vapors are condensed and recovered. The high boiling polysulfides along with a small amount of concentrated caustic are sent to the kraft recovery furnace for burning. D.M.S. product is sent to storage containing 0.001% methyl mercaptan, 0.04% water, and 0.0008% or less polysulfides.

The most important problem to overcome in developing this process was the heat exchange necessary to obtain the high reaction temperature. Black liquor entering the process has a viscosity of 6 centipoise and contains almost 50% organic material. Care must be taken to avoid scorching in the exchanger. With tube side velocities of 6 ft./sec., an over-all heat transfer coefficient of 220 B.t.u./(hr) (°F.) (sq. ft.) has been maintained in the pilot exchanger. Owing to the sugar content of the black liquor some carbonization occurs and the tubes must be cleaned periodically. This is accomplished simply by blasting steam through the tubes. Final temperature boost with sparge steam eliminates many heat transfer headaches. Black liquor dilution resulting has a negligble effect.

All process equipment in contact with high temperature and high pressure black liquor is fabricated from type 316 stainless steel. Mild steel is satisfactory for purification equipment. Brass must be avoided since it will react with methyl mercaptan. Polyethylene or teflon are used for gaskets and packing in contact with D.M.S.

Methyl mercaptan is valuable as an intermediate to methionine. Dimethyl sulfide may be used directly as an odorant or counter-odorant. Its largest potential use is as a chemical intermediate. Dimethylsulfone and dimethyl sufoxide show promise in the solvent and plasticizer fields. D.M.S. may be useful as a sulfur carrier in agriculture and rubber chemicals.

Literature cited

1. Hagglund, E. K., and T. U. Enkvist, U. S. Patent 2,711,430, (June 21, 1955).

Struthers Wells

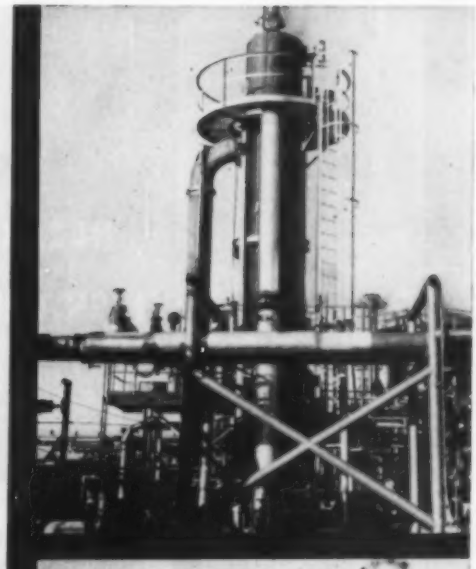
waste heat boilers steam generators

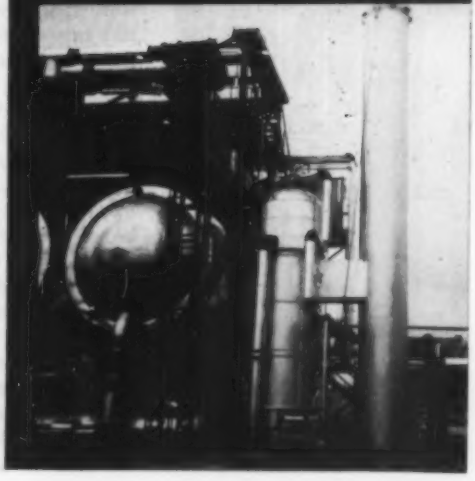
Struthers Wells offers a standard line of Waste Heat Boilers for the recovery of heat from gases and liquids. Four basic types are supplied, to handle a wide range of pressure and temperature, and for special process requirements.

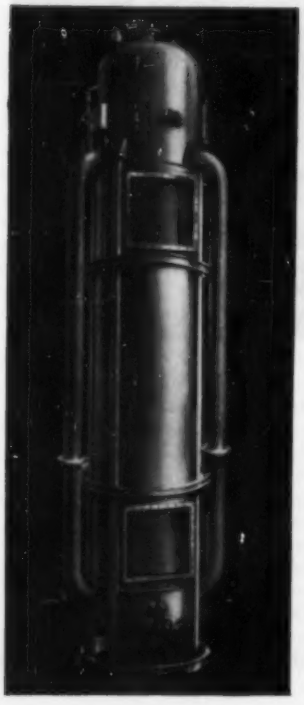
The Struthers Wells WV unit illustrated is designed to recover heat from gas turbine exhaust, high temperature catalytic reactors, and for many other services.

A number of large units are in service for leading chemical and petrochemical companies. The application photos show typical field views; the bottom photo showing one of two units installed for cooling gases from dehydrogenation reactors at a butadiene plant. The upper photo shows one of four units installed in a chemical plant.

If heat is available in high temperature gases or liquids, we will be glad to recommend and quote on equipment for steam generation at the required pressure.







Write!
Bulletin A-60 describes this equipment and is available on request.

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Plants at Warren and Titusville, Pa.

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Use this
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to measure Rate-of-Flow of

HAZARDOUS FLUIDS
HIGH PRESSURE FLUIDS
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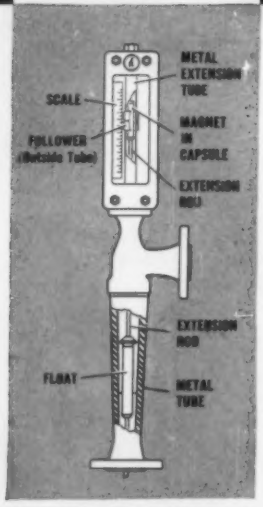

The float extension, see above, contains a magnet. When the magnet moves in the extension tube, the follower (outside the extension tube) follows. The follower position, in relation to the meter scale, indicates rate of flow.

SK Metal-Tube (Armored) Rotameters were specially designed for measuring the rate of flow of hazardous fluids, fluids under high pressures, and steam in chemical, petroleum, and other industrial plants.

These SK Rotameters combine accuracy with sound design and sturdy construction to provide an easy-to-apply, easy-to-use instrument of considerable versatility. For, the Metal-Tube Rotameter can be used for direct reading or it can be arranged for remote indicating, recording, or controlling of fluid rate-of-flow.

This instrument is made for tough service—has a tapered metal tube with flanged connections as shown, metal extension tube, float with magnetic extension, magnetic follower, meter scale, and a sturdy "Safeguard Type" indicator case.

Get additional data on this instrument. Write to SK for Bulletin M-1.

Schutte and Koerting COMPANY
INSTRUMENT DIVISION
2245 STATE ROAD, CORNWELLS HEIGHTS, BUCKS COUNTY, PA.

institutional news

A survey titled "A Study of Certain Future Problems in Chemical Engineering Education" has been authorized by the Education Projects Committee of A.I.Ch.E. A two-part questionnaire is being sent to all departments of chemical engineering. One part will request information concerning the ideas proposed by R. L. White of the Univ. of Michigan and Dean J. C. Elgin of Princeton's School of Engineering on the Chemical Engineering Science Curriculum (see White's article "The Engineer and the Spectrum of Knowledge," *CEP*, May, 1957). The second part will deal with teaching loads and administrative problems, with emphasis on expected larger future enrollments. #

A new College of Engineering will be established next fall at the University of Rochester, Combining the long-established Departments of Chemical and Mechanical Engineering and the new Department of Electrical Engineering. #

Grants totalling $3,499,638 have been approved by AEC for 55 American colleges and universities. The money will be used to expand training facilities for increasing numbers of nuclear engineers and scientists. These grants bring the total amount made available by AEC in the last 10 months to $6,764,388. Most of the money will be applied to the purchase of laboratory equipment. #

The 1957 Supplements to the 1955 Book of ASTM Standards are now available. Published by the ASTM (American Society for Testing Materials) there are seven parts to the supplements, they are supplied in heavy paper covers at $4.00 a part, $28.00 a set.

Part 1—Ferrous metals.

Part 2—Non-ferrous metals.

Part 3—Cement, concrete, ceramics, thermal insulation, road materials, waterproofing, soils.

Part 4—Paint, naval stores, wood, cellulose, wax polishes, sandwich and building constructions, fire tests.

Part 5—Fuels, petroleum, aromatic hydrocarbons, engine anti-freezes.

Part 6—Rubber, plastics, electrical insulation.

Part 7—Textiles, soap, water, paper, adhesives, shipping containers.

Send to American Society for Testing Materials, 1916 Race St., Phila. #

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In Canada: Carbide Chemicals Company, Division of Union Carbide Canada Limited, Montreal.

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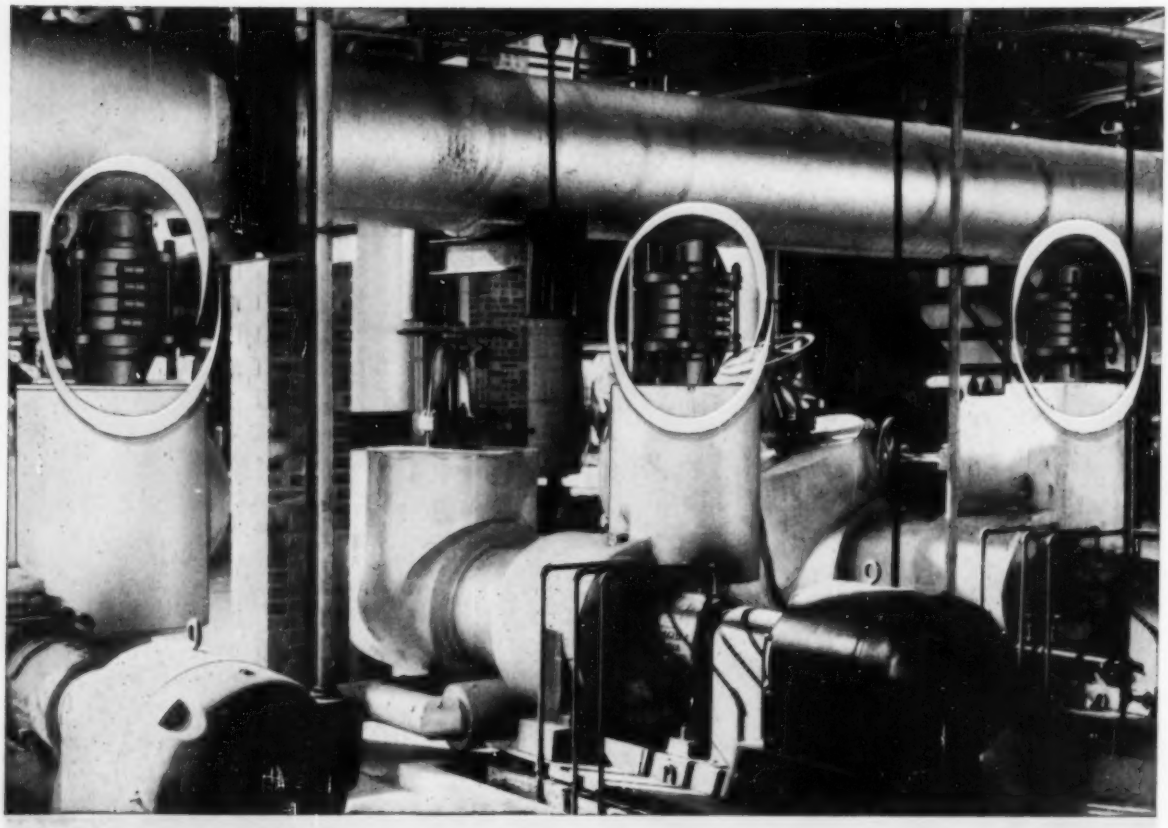


ADSCO CORRUFLEX EXPANSION JOINTS SOLVED A PIPING PROBLEM FOR NATIONAL ANILINE

The new $20,000,000 diisocyanates plant of the National Aniline Division, Allied Chemical & Dye Corp., at Moundsville, W. Va., is known for many engineering wonders, especially its miles of intricate piping. The photo above shows three ADSCO Corruflex anti-compression packless expansion joints used to secure satisfactory piping connections between the main piping and three pumps.

If rigid piping had been used to connect the three pumps to the 18-inch main feeder, the piping soon would have been twisted and overstressed by the growth of the main feeder when hot process liquid was pumped through it. National Aniline engineers, in consultation with ADSCO engineers, decided to use the anti-compression joints shown in the photo. These are deflected laterally with minimum strain on the connecting piping and pumps as the main feeder expands or contracts. Also, the joints absorb vibration of the pumps and motors.

For efficient, right-working pipe line arrangements, use ADSCO Corruflex expansion joints. Packless, they require no maintenance. Sizes, 3" to 54"; for temperatures to 1600 F and pressures to 300 psi.

REMEMBER! Use ADSCO Expansion Joints instead of Pipe Bends because of these advantages:

1. Less Heat Loss **2. Less Pressure Drop** **3. Less Space** **4. Less Cost**

ADSCO DIVISION
20 MILBURN STREET
BUFFALO 12, NEW YORK

YUBA

YUBA CONSOLIDATED INDUSTRIES, INC.

Radio links Dow with offices abroad

A new communication channel links The Dow Chemical Company's overseas sales offices and subsidiaries in Europe with the company's headquarters and plant locations in the United States.

Replacing the previously used teletypewriter system, a new radio circuit between New York and Zurich, Switzerland, has been leased by the company from RCA Communications, Inc., and Radio-Suisse. The facility will assure faster and more efficient servicing of customers overseas as well as savings in operational costs, the company said.

The radio channel is a Dow private line that operates 24 hours a day, seven days a week. However, the company said it will use the line only Monday through Friday. The new facility is arranged so that New York and Zurich stations can send or receive messages at any time during the day. The transmission speed is 15 words per minute.

The existing teletype system serving Dow in the United States is hooked in New York to the new radio channel to Zurich which in turn acts as a relay station for Dow offices in Zurich, Rotterdam and Stockholm, and Nederlandsche Dow Maatschappij, N.V., a Dutch subsidiary in Rotterdam. This provides a direct contact between the European offices and any Dow location in this country.

The opening of the radio circuit between New York and Zurich is the beginning of a planned, fully integrated and privately operated network connecting Dow, Dow Chemical International Limited, and Dow Chemical Inter-American Limited throughout the world. The two latter organizations are export subsidiaries of Dow.

Five specially-designed infrared gas and liquid analyzers are monitoring the safety of the Army's Explorer missile launchings. Developed by Mine Safety Appliances Co., the five units continuously monitor the hydrocarbon content in the liquid air, nitrogen and helium streams with which the missiles are fueled and pressurized. #

Fansteel

Corrosionomics

REGISTERED U. S. PATENT OFFICE

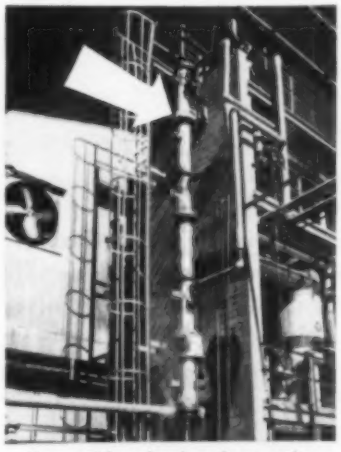
A JOURNAL OF USEFUL INFORMATION FOR THE SOLUTION OF CORROSION PROBLEMS

TANTALUM HEAT EXCHANGER SOLVES HIGH TEMPERATURE HNO_3 PROBLEM

Commercial Solvent's plant at Sterlington, La., produces flake ammonium nitrate by neutralizing nitric acid with anhydrous ammonia. The reaction takes place at 400-460°F., driving off water introduced with the acid. A key piece of equipment in this operation is a Fansteel tantalum heat exchanger which has been giving outstanding service with no visible corrosion noted over a number of years.

Handles HNO_3 at 45 Gal/Min

This Fansteel equipment handles up to 45 gal/min at elevated temperatures with a heat transfer coefficient greater than 550 Btu/hr/sq ft/°F. It is made of three 8-ft. sections in series. If one unit must be removed the other two may be coupled and run at reduced flow. Each unit consists of a bundle of 19 straight tantalum tubes, ½" O.D. and with a 0.015" wall. This gives 20 square feet of heat transfer surface for each section.



Shown without lagging, three-section tantalum heat exchanger raises nitric acid temperature to 330°F.

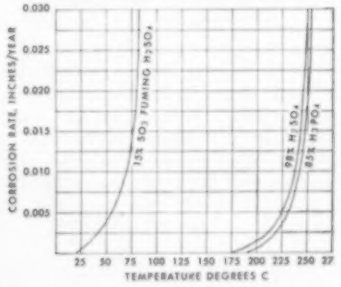
Corrosion Rate Nil in HNO_3

Montecatini, the huge Italian chemical company in Milan, exposed tantalum to 98% HNO_3 containing 0.1% H_2SO_4, 0.4% nitrogen oxides and 1.5% H_2O at 132°C for 762 hours. The corrosion rate was 0.00002 inches per year and the metal was unchanged in appearance. Tests by other companies confirm the low corrosion rates of HNO_3 in all concentrations even at elevated temperatures—as high as 200°C.

"U" Tube Bundles Also Available

Fansteel heat exchangers are also available with "U" tube bundles where processing or physical requirements call for a unit with input and output at the same end. No internal gaskets are used, which makes the leakage problem nonexistent. Teflon* grommets support each tube in the baffle holes and permit free movement, thereby eliminating the differential expansion problem.

Tantalum Also Resistant to Concentrated H_2SO_4 and H_3PO_4

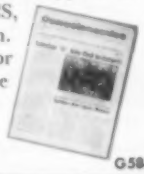


Free Tantalum Test Kit

A corrosion test kit, available without charge to research technicians, if requested on your letterhead; contains both tantalum sheet and wire.

Free Technical Information

The above condensation is typical of the articles which appear in CORROSIONOMICS, a Fansteel publication. Mail us your name for inclusion on our free mailing list.



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For further data on the above, write:

G-584A

FANSTEEL METALLURGICAL CORPORATION

CHEMICAL EQUIPMENT DIVISION

NORTH CHICAGO, ILLINOIS, U. S. A.

Capacitance measurement of density transients

To determine the effects of operating variables on the uniformity of fluidization in a vertical column, density fluctuations within a bed were measured by a capacitance method.

As an ideal condition for maximum solids-gas contact in a fluidized bed, one may postulate a uniform density throughout the bed. However, in practice there are several factors which decrease the uniformity of the bed.

If chemical reactions occur in the fluidized bed, the degree of uniformity could affect performance through its effect on over-all rate, conversion, or selective reactions (if simultaneous reactions could occur). Gas bypassing would cause less over-all contact and conversion. If the reaction mechanism were such that desirable reactions occur at the surface of solids while undesirable reactions proceed in the gas phase, then bubble formation, with its greater gas phase, would favor the undesirable reaction. Because of these possible effects of bed uniformity on chemical reactions, the effects of several operating variables on bed uniformity were investigated.

In a transparent, or open-top vessel only a guess at fluidization uniformity can be made. To measure the interior of the bed quantitatively, a measuring device is necessary which disturbs the fluidization to only a negligible degree. Because of its simplicity, and because it measures only a small segment of the bed, an electrical capacitance method was used.

The capacitance method is based on the large difference in dielectric constant between gases and most solids. The presence of the gas-solids mixture between the plates of a capacitor, as is the case in a fluidized bed, produces an effective dielectric whose constant is proportional to the relative quantity of each phase. Since the dielectric constant is proportional to capacitance*, by measuring the capacitance between the plates of a suitably sized probe placed in the bed, the density may be determined as a function of capacitance. Density may then be calculated from the known dielectric constants of the two phases, or from an empirical calibration of density vs. capacitance over the desired density range.

The application of capacitance to measurement of fluidization characteristics is not new. It was developed independently at the Bureau of Mines *(1)* and at the DuPont Laboratories *(2)*. New information reported here include: improvements in capacitance measurements and calculations over those reported in *(1)* and *(2)*; and the results of a statistical experiment designed to evaluate the independent effects and interactions of six operating variables on uniformity of fluidization in a particular system.

By means of a statistically designed experiment, density measurements were made in a 4-in. diam. column,

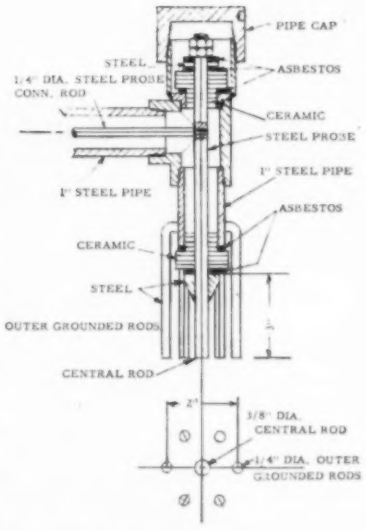

Fig. 1 Capacitance probe.

and certain parts of the experiment were repeated in a 24-in. column for comparison. In the 4-in. column, gas velocity had the greatest effect on uniformity – uniformity decreasing, generally, with increase in velocity. This is consistent with the theory that most gas introduced in excess of the rate for incipient fluidization passes through the bed in the form of various-sized bubbles. That bubbles grow in size as they proceed up the column was indicated by better uniformity at

continued on page 190

*The dielectric constant of a dielectric material is the ratio of the capacitance measured between the plates of a capacitor with the material between the plates, to the capacitance measured between the same plates with a vacuum (or air) between the plates.

Abstracted from "Factors Affecting Density Transients in a Fluidized Bed," by J. M. Dotson, and presented at Chicago meeting A.I.Ch.E., Dec., 1957.

Food from wood wastes now possible

The chemical engineer may soon find himself producing food products from pulp mill wastes according to a Rayonier official. Rayonier, a pioneer in the new field of "silvichemistry", cites low-cost source of animal fodder as the first big potential market.

U.S. chemical engineers and chemists may soon be taking a long second look at the potential for releasing nutritious food elements locked in the waste liquors of chemical cellulose and paper pulp industries. While still in the experimental stage, M. A. Brown, Rayonier official, told a recent ACS meeting that the world-wide need for new food sources has been getting serious attention from the forest products companies.

According to experts in silvichemistry, a new field of science being vigorously explored by Rayonier, the key to large new food sources might be found in the billions of gallons of sulfite waste liquors from the U.S.'s annual production of sulfite-type cellulose and paper pulps. The country has an annual production capacity of 3,250,000 tons of such pulps. Their waste liquors could produce some 250,000 tons of nourishing foods a year.

The key is the yeasts produced through fermentation of wood sugars occurring in these wastes. These yeasts, relatively high in protein, essential amino acids and all the vitamin B group, can be made without producing alcohol, and are a potentially

continued on page 194

TOWER PACKING

All the facts about HARSHAW *tellerettes*

Contained in this comprehensive booklet discussing the application of Harshaw Tellerettes to tower packing.

Subjects discussed at length (accompanied by pertinent charts)

1. The Tellerette Shape
2. Physical Characteristics
3. Lower Capital Investment and Operating Cost
4. Low Weight
5. Reduced Tower Height
6. Increased Tower Capacity
7. Support Plates
8. Corrosion Resistance
9. No Clogging

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Capacitance measurements

from page 188

the lower level. An entirely different gas flow pattern was evident in the 24-in. column.

The probe used was designed to measure the density of a finite volume and to exert a minimum interference on fluidization in its immediate vicinity.

The effective portion of the probe was the volume enclosed by the six outer grounded rods (Figure 1). Together with the central rod, they formed a coaxial capacitance cell 2 in. diam. X 3 in. long. The same probe was used to measure bed uniformity in both the 4-and 24-in. columns. The probe was used in conjunction with a detector and a recorder; the latter having a fixed chart speed of 1 in. / sec.

The 4-in. column was a 10-ft. glass pipe (Figure 2) with gas distributor at the bottom, and two metal spacers for alternate positioning of the probe. Two types of gas distributor were used with this column: a 1-in. thick disk of porous carbon, or an orifice type having a 0.073 in. diam. hole every 1.8 sq. in.

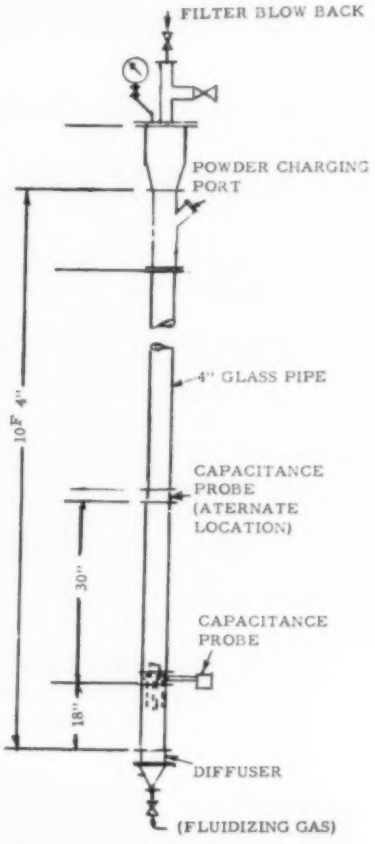

Fig. 2 Four-in. diam. column.

The 24-in. column was made of steel, and contained eighteen vertically mounted 2-in. pipes, arranged to stimulate a heat exchanger coil. Only the orifice-type distributor was used in this column. It had the same hole size and spacing as the distributor used in the 4-in. pipe.

Fluidizing used gas was a mixture of N_2 and CO_2 in 85 to 15 volume ratio. Solid phase consisted of metallic silicon and copper powder in 97/3 wt. ratio; the former of 60 and 200 mesh, the latter of (80% below) 10 microns.

To measure the effects of the various variables on bed density, weighed quantities of powder were charged to desired bed heights at adjusted gas velocities of 0.3, 0.5, 0.7, and 0.05 ft. / sec. Fluidization nonuniformity

continued on page 192

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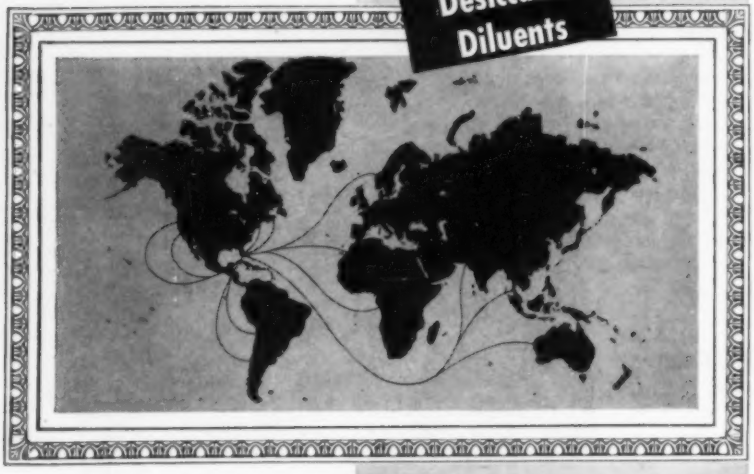

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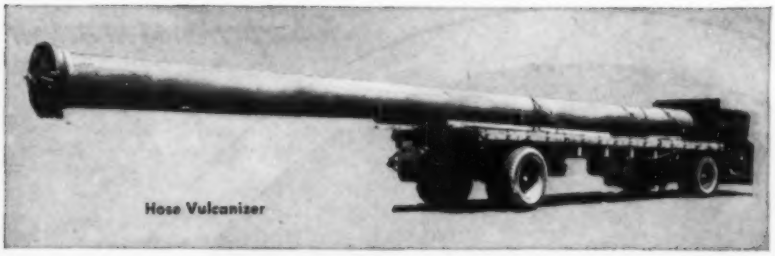
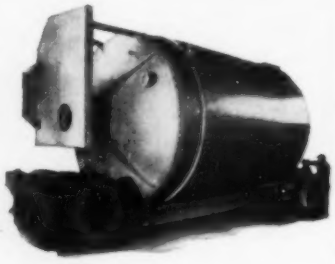


Hose Vulcanizer

Acid tank made of steel



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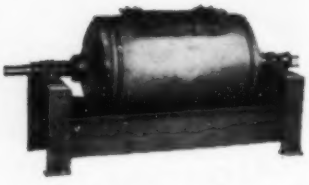

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Capacitance

from page 190

was calculated in terms of percent variation in density, defined as

$$\frac{\text{var. in density, lb./cu.ft.}}{\text{aver. density, lb./cu.ft.}} \times 100$$

The variation in density represented an integration with respect to time, of the irregularity above and below the average density as calculated from the recorded values of probe capacitance over a definite time interval.

The method of calculation employed allowed for the nonlinearity between density and the effective dielectric constant.

The effects of the five operating variables: distributor type, bed height, probe height, powder grind, and gas velocity, plus all interactions, were determined.

Conclusions were:

4-in. Column

1. Over the ranges studied, all operating variables except bed height had a measurable influence on the uniformity of density throughout the bed.
2. Gas velocity through the powder bed had by far the greatest effect on uniformity, with uniformity generally decreasing with an increase in gas velocity. This was interpreted to mean that most gas introduced in excess of the rate for incipient fluidization passes through the bed in the form of various-sized bubbles.
3. Better uniformity at the lower bed level indicated that bubbles grow in size as they proceed up the column.
4. Bubble growth is accelerated by a coarser powder.
5. Fine powder promotes the formation of gas channels or bubble paths at low gas velocities in the lower section of the powder bed.
6. Except in the vicinity immediately above it, the type of distributer has relatively little effect on uniformity.

24-in. Column

7. The more uniform density (in comparison to the 4-in.) found in the horizontal center of the 24-in. column is believed to be not representative of the entire bed.
8. Gas channels, or distinct bubble paths, are believed to be present in the column.

Literature Cited

1. Dotson, J. M., *et al.*, *Chem. Eng.*, *56*, 128-30, (October, 1949).
2. Morse, R. D., and C. O. Ballou, *Chem. Eng. Progr.*, *47*, 199-204 (1951).

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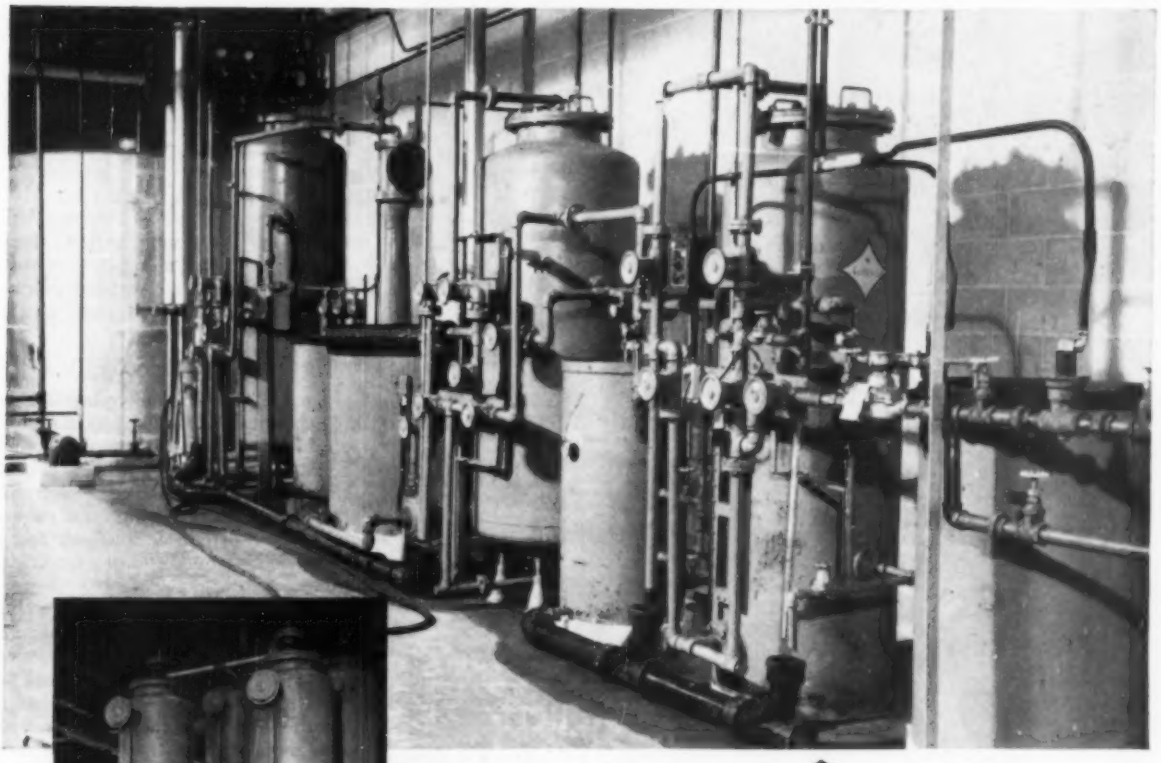

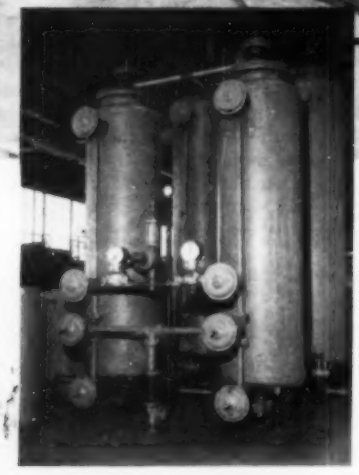

EXAMPLE 1: *Purification of Formaldehyde.* Specialized anion exchange technique removes formic acid from formaldehyde. This *Industrial* semi-automatic, dual unit also "up-grades" water white formaldehyde for resin manufacture—yields final resins with resistance to off-color blush or bloom.

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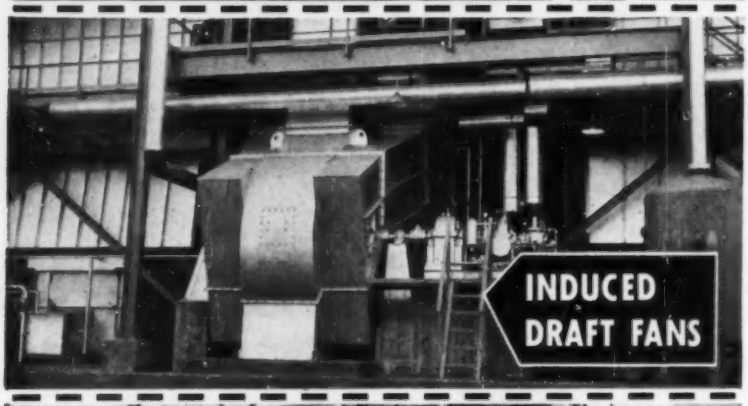

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Food from wood

from page 188

low-cost source of human food. The tree-derived yeasts also provide excellent fodder for cows and oxen which in turn produce food for man, according to Rayonier.

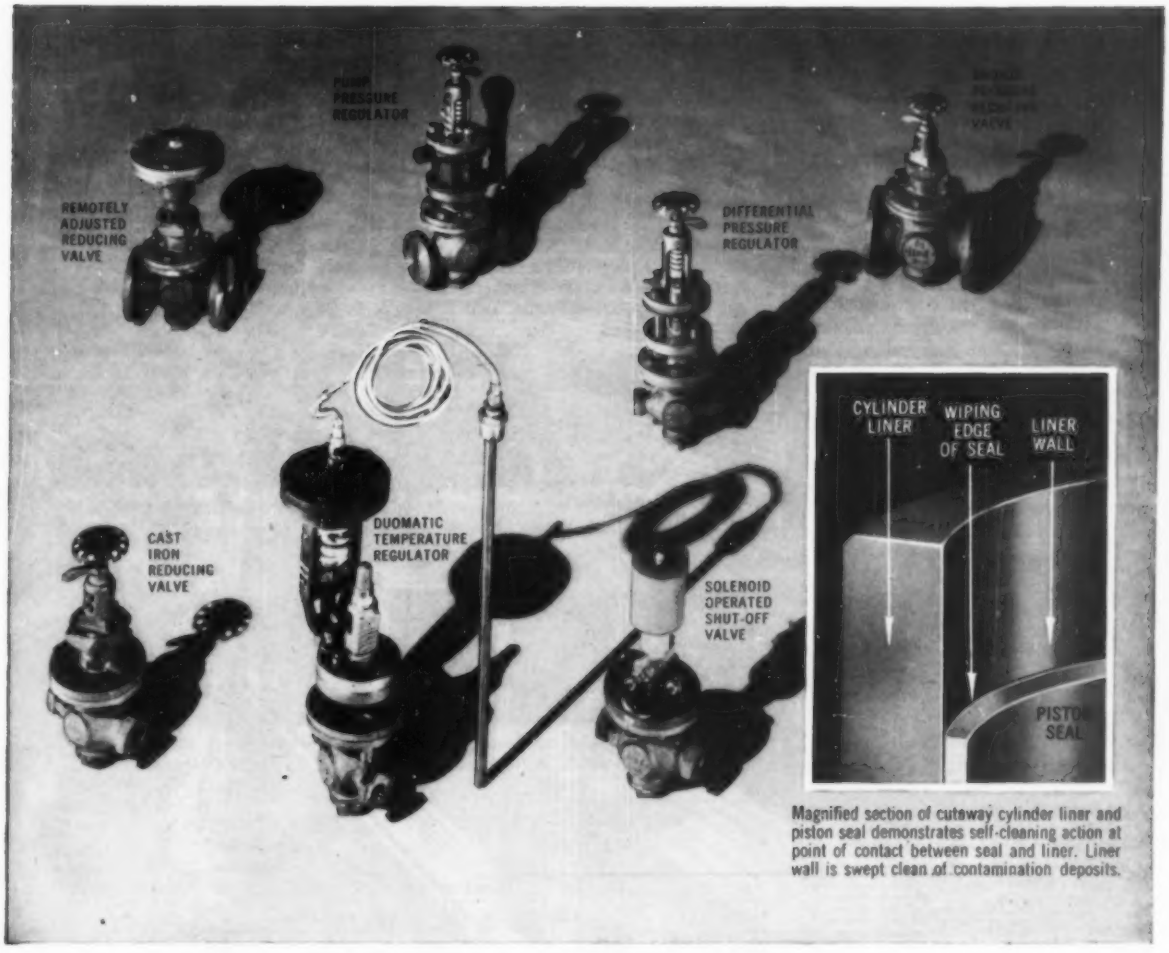
But current production costs are high, only about 7500 tons of such yeasts are being produced annually in the U.S. This relatively small tonnage is being used as food supplements for livestock, poultry and fish. Production costs of these yeasts still run 5¢ to 7¢ a pound, making them expensive as food, although they may already be attractive as food supplements because of their rich protein and vitamin content.

Silvichemical growth

Several new products classified as silvichemicals are now in commercial production by Rayonier and other forest products companies. These range from oil well drilling mud dispersants, binding agents and rubber extenders, to food antioxidants and a conspicuous number of medicinal intermediates.

Although they are only now beginning to attain commercial importance, silvichemical products produced last year in the U.S. amounted to some $38,000,000 "at the producing point." This figure includes only alcohol, lignosulfonates, vanillin, some yeast, tall oil, sulfate turpentine, and bark extract.

A 250 percent increase in capacity of sulfuric acid production is the result of the building of a new facility adjacent to the Beaumont, Texas, plant of Olin Mathieson Chemical. The major part of the new construction is a 500 ton a day sulfuric acid plant which includes the giant, cauldron-shaped clarifier (above) which takes the impurities out of the water before it enters the boilers, and a special scrubber to keep sulfur dioxide from the air. The scrubber is based on the Cominco Process for which Olin Mathieson is exclusive licenser in the U.S.



Magnified section of cutaway cylinder liner and piston seal demonstrates self-cleaning action at point of contact between seal and liner. Liner wall is swept clean of contamination deposits.

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21-and-over club expands membership

Results of the 1957 membership drive, now in, show that the chairmen of 13 local sections mustered up 21, or more, applications for new membership during the year. These chairmen comprise the exclusive "21-and-over" club. Their pictures, along with John McKetta, National Membership chairmen, and his assistant, E. Matt Jones appear here.

1,185 applications, representing 60% of the 2,000 goal, were received during the year as the direct, or indirect, efforts of these drivers. This was a gain of 65% over the 1956 figures. Sam West's colors came in first with 182 members, while those southern boys were second with 168. It doesn't make too much difference how you slice it, the larger sections lead either way. On the basis of total number of applications for 1957, with percentage increase in parentheses:

Philadelphia-Wilmington (17.5%)	182
South Texas (27.5%)	168
New York (23.8%)	95
New Jersey (8.7%)	65
Pittsburgh (17.3%)	62
Chicago (8.2%)	47
So. California (10.5%)	46
Charleston (8.8%)	40
Midland (10.2%)	29
Twin City (16.9%)	22
Maryland (9.0%)	21
N. California (4.6%)	21
St. Louis (3.5%)	21

About 65 percent of the new applications for membership were accounted for by only ten local sections. This may be indicative of the country's industrial concentration or the driving power of the respective local membership committee chairmen, or both.

It is significant to note that for each of the last three years that McKetta has chairmanned this committee, more applicants were produced than the year immediately preceding. This has been the greatest period of consistent growth in the history of the Institute. Considering the great number of chemical engineers who have not yet joined the Institute, this rate of growth will undoubtedly continue.

Complete figures are given in the accompanying tables. How did your section come out? If you can help your representative to get more members in 1958, he'll appreciate your help, and so will AIChE.

continued on page 198

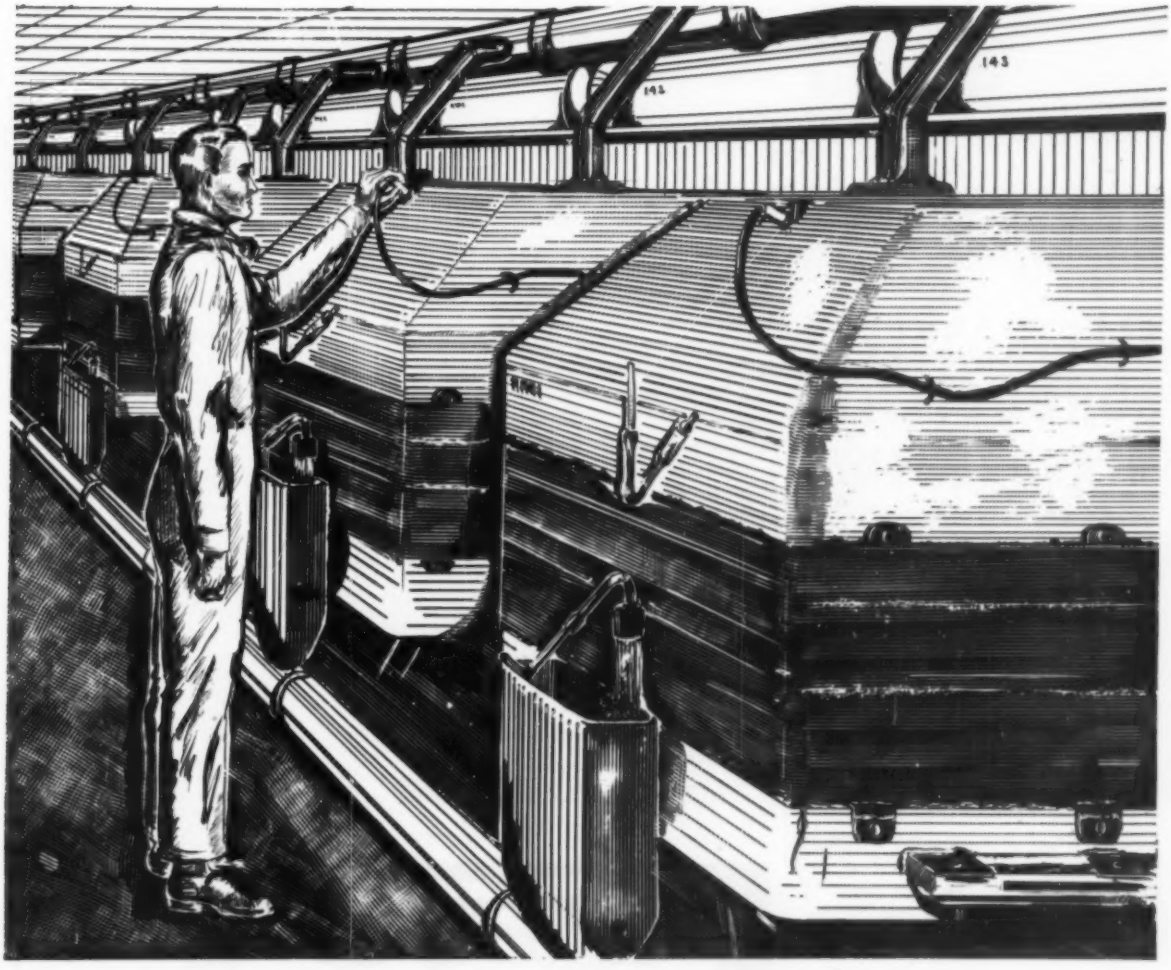
(L. to r.) J. J. McKetta, A.I.Ch.E. Membership Comm. chmn; E. Matt Jones, A.I.Ch.E. Membership Comm. vice-chmn; E. M. Glazier, Pittsburgh; C. C. Japs, Twin Cities; A. C. Goodman, S. Cal.

(L. to r.) R. E. Stroup, St. Louis; J. F. Valle-Riestra, N. Cal.; W. F. Schurig, New York; A. J. Luhks, Jr., New Jersey; J. M. Price, Maryland.

(L. to r.) I. Liebson, S. Texas; J. R. Bircher, Midland; A. S. West, Phila.-Wilmington; R. A. Hoppe, Charleston; R. E. Pritz, Chicago.

Section	Members[1]				New Member Applications 1956	1957	Representative
Akron	120	+	50	= 170	11	9	T. F. O'Brien
Alton-Wood River	.....				2	5	C. J. Barr
Atlanta	54	+	53	= 107	5	5	F. Bellinger
Baton Rouge	140	+	27	= 167	22	18	R. J. Fritz
Boston	103	+	42	= 145	11	16	C. W. Angell
Central Ohio	96	+	0	= 96	2	15	L. C. Hullinger
Central Oklahoma	14	+	30	= 44	1	0	M. S. Worley
Central Pennsylvania	26	+	50	= 76	3	2	.....
Central Virginia	35	+	88	= 123	5	5	W. R. Horne
Charleston	444	+	12	= 456	45	40	J. F. Kaemmerer
Chicago	525	+	50	= 575	39	47	R. E. Pritz
Cleveland	423	+	0	= 423	21	13	F. R. Carvell
Coastal Bend	37	+	37	= 74	1	6	W. J. Humphrey
Coastal Georgia	20	+	0	= 20	4	0	R. H. Stevens
Columbus Valley	.....				9	10	H. H. Hubble, Jr.
Dallas	.....				3	6	D. C. Penick
Detroit	115	+	55	= 170	12	16	W. Leisten
E. Tennessee	105	+	0	= 105	6	12	O. Wimbish
El Dorado	38	+	38	= 76	7	5	O. Fuchs
Great Salt Lake	15	+	30	= 45	2	5	L. V. Durland
Idaho Falls	29	+	56	= 85	4	7	R. Walton
Kansas City	60	+	80	= 140	9	6	R. A. Byorum
Knoxville-Oak Ridge	49	+	103	= 152	7	5	J. E. Rothfleisch
Louisville	67	+	12	= 79	3	10	H. A. Bennett
Maryland	225	+	10	= 235	21	21	J. M. Price
Memphis	30	+	48	= 78	10	4	L. Roman
Midland	170	+	115	= 285	13	29	H. W. Smeal and J. R. Bircher
Nashville	15	+	10	= 25	1	0	R. O. Adams
National Capital	35	+	119	= 153	0	6	P. S. Forsyth
New Haven	38	+	14	= 52	3	5	C. Nelson
New Jersey	462	+	288	= 750	26	65	A. J. Luhks, Jr.

[1] The first number represents members of National A.I.Ch.E., the second represents non-members of A.I.Ch.E. National Society. Note that 12 sections require that their members be national members also.



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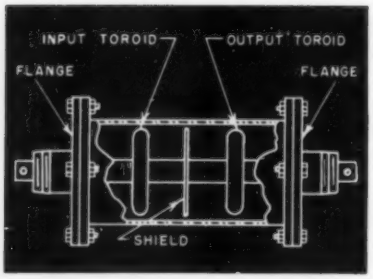

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21-and-over club

from page 196

Section	Members[1]				New Member Applications 1956	1957	Representative
New Orleans	115	+	0	= 115	6	2	R. H. Stewart
New York	325	+	75	= 400	16	95	W. F. Schurig and J. Henry
N.E. New York	60	+	70	= 130	2	17	B. I. MacDonald
No. California	305	+	155	= 469	24	21	J. F. Valle-Riestra
Ohio Valley	77	+	35	= 112	7	11	L. Rogovin
Oklahoma	55	+	10	= 65	6	12	E. W. Mellow
Pensacola	30	+	70	= 100	..	1	.....
Phila.-Wilmington	1,040	+	0	= 1,040	98	182	A. S. West
Pittsburgh	358	+	0	= 358	54	62	E. M. Glazier
Rhode Island	19	+	58	= 77	1	3	F. Votta, Jr.
Rochester	90	+	290	= 380	3	11	B. M. Thompson
Rocky Mountain	.....				4	5	M. T. Howerton
Sabine	130	+	69	= 199	9	13	H. Taylor
Savannah River	65	+	52	= 117	11	13	R. Waugh
So. California	437	+	0	= 437	26	46	A. C. Goodman
So. Texas	614	+	0	= 614	110	168	I. Leibson
St. Louis	500	+	100	= 600	22	21	R. E. Stroup
Tennessee Valley	74	+	15	= 89	7	13	C. Culverhouse, Jr.
Terre Haute	.....				1	4	J. C. Jackson
Texas Panhandle	30	+	57	= 87	6	9	C. M. Oktay
Tidewater Virginia	58	+	42	= 100	4	8	J. E. Cooper
Toledo	21	+	66	= 87	3	2	W. Danekind
Tulsa	62	+	7	= 69	2	8	G. Borden
Twin City	60	+	70	= 130	4	22	C. C. Japs
Washington-Oregon	28	+	15	= 43	3	16	F. Shelton
W. Massachusetts	120	+	0	= 120	14	18	J. E. Swan
W. New York	290	+	50	= 340	..	..	
Total	8,473	+	2,700	= 11,173	764	1,185	

A flexible compact unit that combines a powerful disperser head with a rugged diamond-shaped agitator to produce finished homogeneous batches without further processing—for most chemicals, inks, plastics, pharmaceuticals, cosmetics, paints, and industrial finishes.

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These desirable characteristics expand the application of the Vanton plastic pump line to a broad range of corrosive fluids, abrasives, slurries, and other solutions which must be pumped without contamination at elevated temperatures.

The new Marlex 50 Vanton Pump, like all other Vanton self-priming pumps, is available in a wide variety of interchangeable plastic body blocks, and rubber or synthetic flex-i-liners; and in capacities of ⅕–40 GPM. For more information, circle #512 on coupon below.

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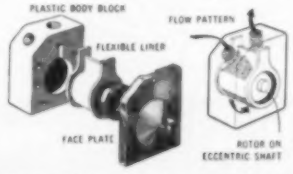
Vanton Design Eliminates Stuffing Boxes, Shaft Seals

Basic Vanton design avoids the problems associated with stuffing boxes and shaft seals by eliminating the seals themselves! All fluid moves in a channel formed between molded plastic body and synthetic interliner. No liquid touches metal. Pumping mechanism is rotor, inside the liner, mounted on eccentric shaft. At each revolution it creates a progressive squeegee action on the fluid trapped between the liner and the housing. Available in a variety of plastic materials, including Teflon* and Kel-F Elastomer**. For further information, circle 511 on coupon and mail to Vanton. Or, for a demonstration of this unusual motor-pump unit, see your nearest dealer.



*Reg. Trade mark of E. I. DuPont.
**Reg. Trade mark of Minn. Mining & Mfg. Co.

Vanton Pump & Equipment Corp.
Hillside, N. J.

Please send booklet circled: **511** **512**

NAME_____

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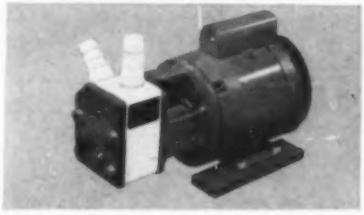
Teflon* Sealless Pump Now Available In Close-Coupled All-Purpose Portable Motor-Pump Unit



Portable Vanton Motor-Pump Unit, with convenient handle and platform, in variety of plastic constructions, has wide application for general utility, standby, and process applications

No-Shaft-Seal Principle Eliminates Leakage and Corrosion, Minimizes Maintenance for Wide Range of Pumping Problems

Here at last is a portable all-purpose motor-pump unit to handle *all* your ⅕-10GPM pumping problems! This pump's unusual no-stuffing-box design eliminates leakage, corrosion, and contamination, and minimizes maintenance. Provided with a convenient handle, and mounted solidly on a platform, this unit will find wide use in pumping all kinds of corrosive, abrasive, pharmaceutical, and plain ordinary industrial fluids encountered in plant operations.

This brand-new motor-pump model is an adaptation of the unique Vanton Plastic Pump that has been performing so outstandingly under the most difficult pumping situations to be found in the chemical industry today. Vanton has taken the basic design principle of this pump (NO STUFFING BOX OR SHAFT SEALS) and by skillful engineering has produced a portable motor-pump unit that for versatility, convenience, and corrosion and abrasion resistance has no equal on the market today.

PUMP PERFORMANCE DATA[1]

MODEL NO.	CAPACITY Gals./Min.[2]	OPERATING PRESSURE RANGE Lbs./sq. in. gauge	
		INTERMITTENT	CONTINUOUS
2	0.33	0-20	0-10
6	1.0	0-25	0-15
12	2.0	0-30	0-25
18	3.0	0-35	0-30
30	5.0	0-45	0-30
60A	10.0	0-40	0-30

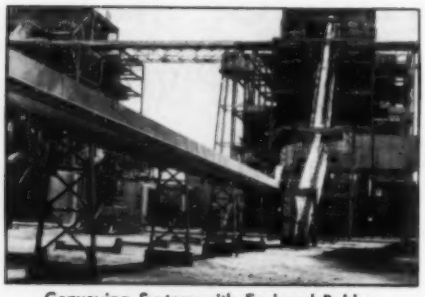
(1) 1750 rpm, ¼ H.P. all models, except 60A (½ H.P.) (2) Water at 70° F., against zero head.

VANTON PUMP and Equipment Corp. • Hillside, N. J.
DIVISION OF COOPER ALLOY CORP.

BUHLER

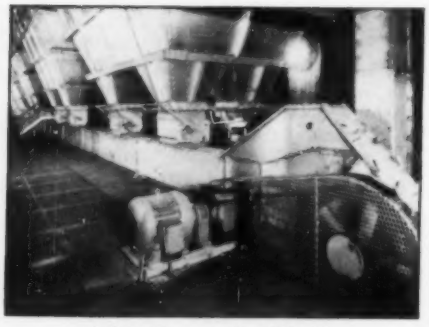
ENCLOSED CONVEYOR FOR

BULK CHEMICALS



Conveying System with Enclosed Buhler Conveyors for the conveying of hot (900° F.) char and lignite.

PHOSPHATES
SULPHATES
SODA ASH
PLASTIC POWDER
POTASH, etc.



Buhler Conveyor for 100 t/h finely ground phosphate.

ADVANTAGES
of Buhler Conveyor—

1. Dustfree, sanitary operation
2. Saves space
3. Minimum maintenance— no lubrication points
4. Careful handling of materials
5. High capacity
6. Conveys hot materials up to 1200° F.
7. No explosion risks
8. Can be made pressure tight, i.e. material can be conveyed with protective gas above layer of material
9. Adaptable for vertical, inclined and horizontal positions

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Sales Representatives: Hans Zogg, Los Altos, Cal. • Arthur Kunz, New Orleans, La.

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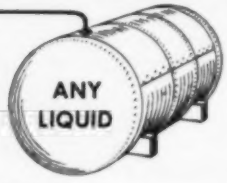
FOR MEASURING TANK CONTENTS ANY DISTANCE AWAY



TANK MAY BE BURIED, ELEVATED, OPEN, CLOSED, VENTED OR UNDER PRESSURE OR VACUUM

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Absolute Pressure (Mercury Column)
Pressure and Vacuum
Differential Pressure
Inclined Manometers for draft, pressure or differential pressure.

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institutional news

Now available, at $1.00 a year, are the Transactions of The Chemical Engineering Division of the American Society for Engineering Education. The latest issue, covering 1956-57 includes important papers by D. L. Katz of Michigan, V. L. Parsegian of Rensselaer, and E. N. Lightfoot of Wisconsin. #

An intensive course—Advances in Design and Operation of Distillation and Absorption Equipment—will be given at the Univ. of Michigan, July 7-16. The topics include tray layout considered from transfer rate and hydraulics viewpoints, efficiency predictions based on the latest research programs including that of A.I.Ch.E., new types of trays, application of computers including the use of the university's IBM 650 as well as equilibria, physical properties, trouble shooting, auxiliaries and component layout. Limited to 35, the course will be taught by J. A. Davies, The Texas Co., Professors Brymer Williams and K. F. Gordon, Chemical Engineering Dept. of Michigan. #

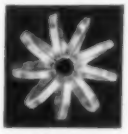
A subcritical nuclear reactor and allied equipment will be purchased by Syracuse Univ. as part of a plan to expand its nuclear science and technology programs. Money is being made available to the university by an AEC grant of $80,396. AEC will also provide materials of uranium and plutonium-beryllium. #

The Third Annual summer program in Nuclear Energy for Industry will be held on the Berkeley campus of the University of California during the months of June, July and August 1958. The program is designed to acquaint executives and administrators with the nontechnical aspects of nuclear science, as well as to provide more technical courses for engineers in the field. #

Fifth Annual Symposium on Computers and Data Processing will be held at the Albany Hotel, Denver, Colo., July 24-25. Sponsor is the Electronics Division of Denver Research Institute, Univ. of Denver, and the program will consist of two days of technical papers at an advanced level on basic problems in the field of data processing. #

Partition Ring

Spiral Ring



Plastic Tellerette

Lessing Ring

Raschig Ring

Ceramic Berl Saddle

SPECIALISTS in Tower Packings

Here are several types of tower packing made in one of the Knight plants, the largest in the country specializing in tower packing production.

Knight packing includes the popular and efficient Berl Saddles made of unglazed porcelain and chemical stoneware. Both are sturdy, nonspalling and entirely acid proof. Berl Saddles, made of Permanite or steel, are available for use with strong caustic solutions or HF.

Knight makes other tower packings — including Raschig, Lessing, spiral, and partition rings. We also furnish the new polyethylene Tellerette packing shown.

Data concerning sizes, weights, surface area, etc., on our various types of tower packings is given in Knightware Chemical Equipment Bulletin No. 11 — Write for your copy.

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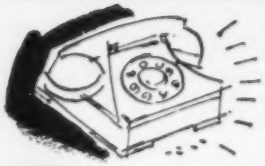
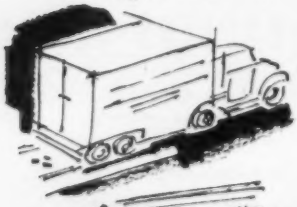


INQUIRIES ARE ANSWERED PROMPTLY—Whenever you call or write for information on prices, availabilities or service, you get a prompt reply.



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INSTALLATIONS ARE CHECKED—At Cambridge, orders aren't filled and forgotten. Our own sales engineers follow up your order to make sure our product is giving you the best possible service.

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OFFICES IN PRINCIPAL INDUSTRIAL CITIES

overseas news

Montecatini to triple polypropylene production

Montecatini, giant Italian chemical firm, plans to triple polypropylene production, announces development of new materials including a special 1-4 *trans*-polybutadiene which behaves like muscle protein.

Only recently put on stream to produce 15 million pounds a year of isotactic polypropylene materials, Montecatini's new Ferrara plant is already in the process of being expanded to produce 45 million pounds a year of the new plastic.

The first installation in the world to commercially produce the polypropylene, the Ferrara plant will use an improved and simpler process in its expanded facilities. Export is undoubtedly in the works for polypropylene, since the company cites overseas demand as one of its reasons for expanding.

Already Montecatini's export sales are increasing. Last year, while gross sales increased by 5 percent, total exports increased by 12 percent.

Experimental polymers

A new polybutadiene, now under laboratory test, which can be extruded and stretched to produce crystalline fibers which behave much like muscle proteins; and a new synthetic rubber with properties similar to natural rubber are among the new chemicals under study at Montecatini.

Of great scientific interest, the "1-4 *trans*-polybutadiene" behaves very much like muscle proteins in that a reduction of length of the oriented synthetic fiber results in the transformation of the fiber from one crystalline phase to another. The other, a "1-4 *cis*-polybutadiene" has many of the properties of natural rubber with excellent tensile strength in the absence of fillers.

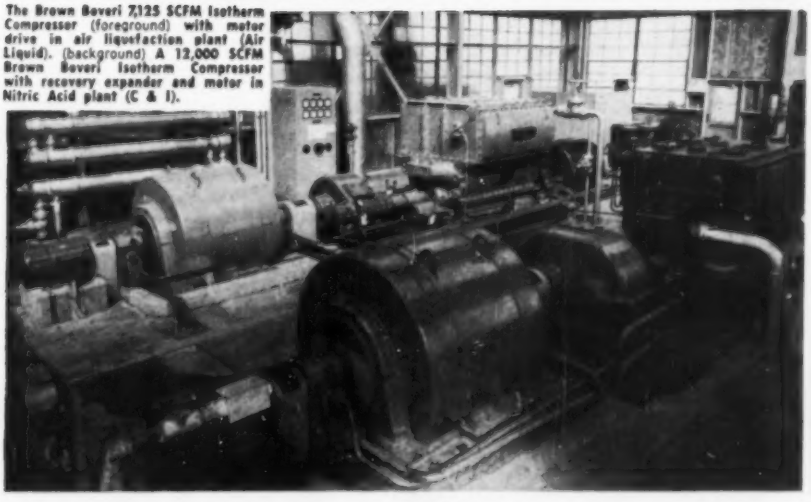
To develop world markets for its vinyl stabilizers and plasticizers, Argus Chemical Corp., Brooklyn, N.Y., has joined with Union Chimique Belge of Brussels in the formation of a new company, and has made a licensing arrangement with Lankro Chemicals, Ltd., of Manchester, England. #

for –

Large Volume*
Medium Pressure*

Oil-Free Air
at Lower Cost

The Brown Boveri 7,125 SCFM Isotherm Compressor (foreground) with motor drive in air liquefaction plant (Air Liquid). (background) A 12,000 SCFM Brown Boveri Isotherm Compressor with recovery expander and motor in Nitric Acid plant (C & I).



the

BROWN BOVERI ISOTHERM COMPRESSOR

WHERE large volumes of oil-free air (5,000 SCFM and up, 100-300 PSIA)* are required, there is no better equipment available today to achieve "close to isotherm" type of compression, assuring the lowest possible kW input, than a Brown Boveri Isotherm Compressor.

If "tail" gas is available, the high efficiency, reaction type Brown Boveri expander can be applied in the cycle with the Isotherm Compressor to improve further the economy of the process. As drive for the compressor a synchronous, induction or other type of motor, or a steam- or gas-turbine can be used.

Over half a century's background in the manufacture of this Brown Boveri equipment (including control and all accessories) is your positive assurance of the ultimate in the reliability of this "packaged" unit. Write for more information, *today!*

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permanent magnetic force...

A sleeve, raised and lowered within a nonmagnetic tube, attracts or releases an Alnico magnet attached to the mercury (or dry contact) switch. Basically, this is Magnetrol.

The operating principle behind MAGNETROL LIQUID LEVEL CONTROL

Because its operating principle, based on the proper use of a permanent magnet, guarantees a perpetual guardianship over your critical liquid levels, the Magnetrol liquid level control unobtrusively takes the most important place in any system or process where it is necessary to keep a liquid at a constant level. Principle and action are so simple that failure is virtually impossible. Magnetrol is versatile, too—will handle almost ANY liquid, at ANY temperature, at ANY pressure, with the same precision and dependability. No mechanical or electrical linkages to stick, bind, ride out of line or wear out. Available for controlling level changes from ¼" to 150 ft. Multi-stage switching when desired. Write to

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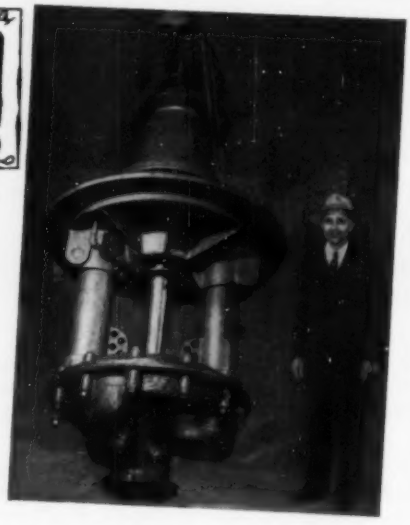
If you must pump highly abrasive mixtures, corrosive liquids, hot solutions or heavy slurries, then you will save by using NAGLE CENTRIFUGAL PUMPS. Engineered to your specific requirements—The right design, the right materials of construction. Horizontal and vertical shaft types in complete range of sizes. Send for Catalog 5206.



• Modified type "SW-O" vertical shaft pump built by Nagle for severe service in an atomic energy plant.

NAGLE PUMPS

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PUMPS FOR ABRASIVE AND CORROSIVE APPLICATIONS

overseas news

The first triple super phosphate plant to be constructed in Mexico will be designed and engineered by Dorr-Oliver. The 150 metric ton a day plant will be located near Coatzacoalcos, Veracruz, and will employ the standard Dorreo Granular Fertilizer and Dorreo Stron Phosphoric Acid Processes. Mexican operator-owner will be Guanos y Fertilizantes do Mexico, S. A. #

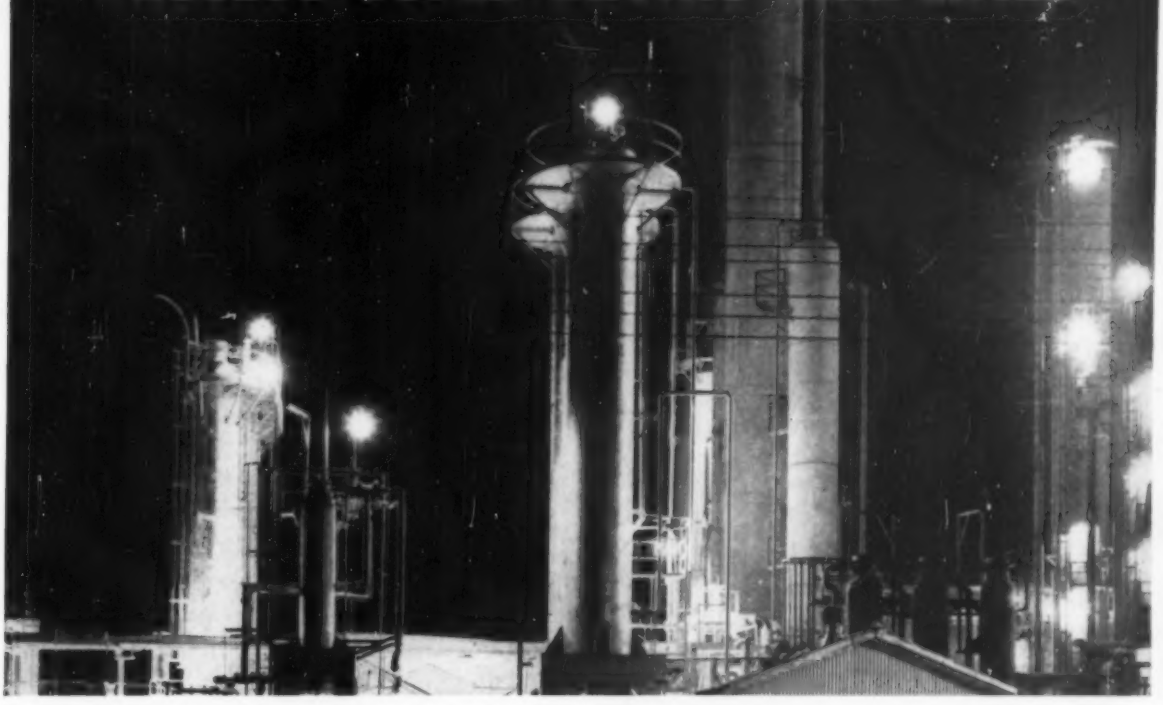
High impact polystyrene will be produced by C. S. R. Chemicals Pty. Ltd. of Australia under license from Dow Chemical. Dow engineers have assisted in the planning of a plant now near completion at Rhodes, N. S. W. Staff members of the Australian firm have just completed six weeks of technical conferences with Dow at Midland Mich. #

A wood naval store plant, annual capacity 25 million pounds, has just been opened in Mexico by Corbu Industrial, S. A., a company in which Hercules Powder has a major interest. Corbu will produce rosin, turpentine, pine oil, and other terpene chemicals to be sold in Mexico and exported as well. #

Three unusually large (60 ton) compressors were shipped recently to British Petroleum Co. Ltd.'s Kwinana, Australia, refinery by M. W. Kellogg. Here one of the specially constructed crates is loaded onto the ship. The compressors will be used in British Petroleum's new Reforming unit now under construction in Australia. #

A new company to produce silicon carbide for the Argentine market has been formed by Norton Co., Worcester, Mass., and Carbometal, S. A., of Mendoza, Argentina. The $500,000 project is scheduled for completion at the end of 1958. #

PROCESS SUPER DRYING SIMPLIFIED



MHI CALCIUM HYDRIDE drys materials completely in gas or liquid phase

Versatility, almost unlimited . . . effectiveness, process proved . . . MHI calcium hydride is simplifying today's "tough nut" complete drying problems! MHI calcium hydride is uniquely successful in those new processes where water *can't be tolerated.* Included are catalysis systems for polymerization, the preparation of refrigerants, aerosol propellants, pharmaceuticals, and nuclear reactor atmospheres. MHI calcium hydride has an unequaled ability to dry *completely* in unit processes involving gases, such as hydrogen, argon, helium, nitrogen, hydrocarbons, chlorinated hydrocarbons, esters, alcohols, and many other types of compounds.

HERE'S HOW IT SIMPLIFIES. Even at elevated temperatures where adsorbtive type driers are ineffective, MHI calcium hydride drys completely. Contact with MHI calcium hydride can be in stirred tanks, by percolation through a fixed bed of calcium hydride, or vapor phase through a fixed bed. Temperatures can range from below room temperature *up to 1400°F.* Contact times may be as short as a few seconds. Calcium hydride is safe and easy to use and store.

EFFECTIVENESS OF CALCIUM HYDRIDE FOR YOUR PROCESS EASILY PROVED. With your own titrimeter, you will see how MHI calcium hydride drys residual moisture down to dew points of less than —60°F or to one p.p.m. range. Metal Hydrides Incorporated will gladly provide samples upon written request.

NEW CALCIUM HYDRIDE TECHNICAL BULLETIN AVAILABLE. You may get details on complete drying with MHI calcium hydride by requesting your copy of this new bulletin.

PIONEERS IN HYDROGEN COMPOUNDS

M H i *Metal Hydrides Incorporated* CHEMICAL HYDRIDE DIVISION

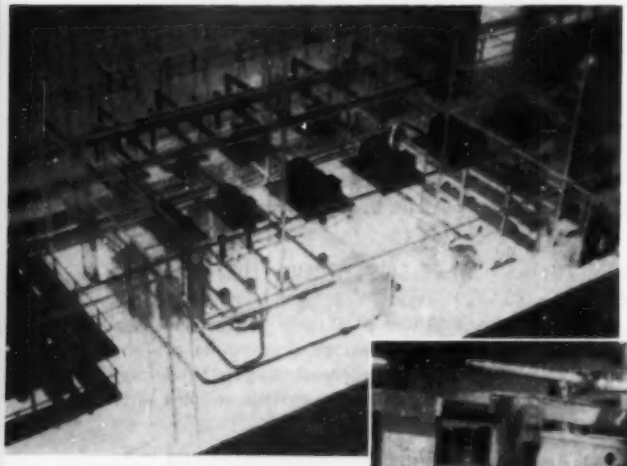
CONGRESS STREET, BEVERLY, MASSACHUSETTS

In the large turnout of engineers and scientists at the Congress and AtomFair were many overseas visitors, some of whom are shown here.

NUCLEAR CONGRESS

Russian delegates are welcomed by H. Isbin, past-chmn., Nuclear Engineering Division (left). Others, (l. to r.) are: V. Spitzin, S. V. Mamikonan, I. T. Aladiev, all U.S.S.R.

They came from all over the world, including the U.S.S.R., to attend the recent 1958 Nuclear Congress and Atom Fair in Chicago. Among the large, and scientifically illustrious, turnout were delegations from West Germany, Italy, Japan, and India, to name only a few noted by CEP reporters. All-in-all, the Congress and Fair proved one of the biggest and most interesting to date, showed the particularly important advances made in the U.S. in large-scale installation equipment.

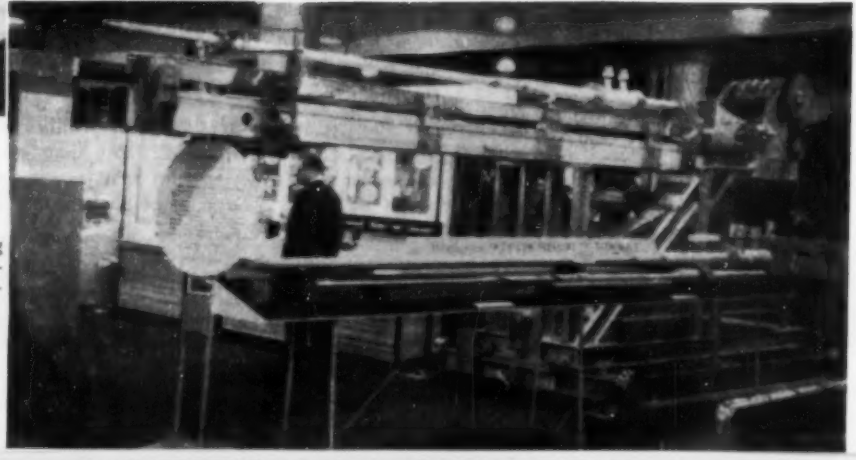


Reprocessing plant models were numerous at the Fair.

AtomFair

In general, exhibits represented a greater concentration of material prepared for large-scale nuclear installations, or similar to that used in such installations.

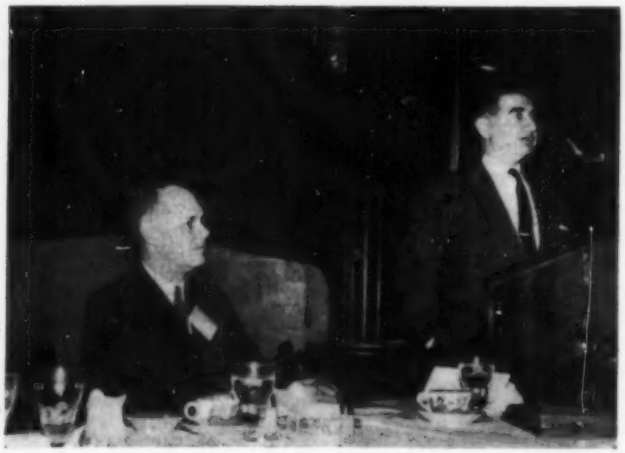
Zirconium pump casting was said to represent advanced technology.



This device is for inserting and withdrawing sample material into and out of a radiation field underwater.

Vice-President Nixon drew many pleasant responses (above) during his prepared talk, then chatted with members of the audience for nearly half an hour (right).

Gathered dignitaries: (l. to r.) Dean Dunning of Columbia, the toastmaster; Mr. Nixon; Adm. Strauss, AEC chairman who introduced Mr. Nixon; and Mr. Maxson, Commonwealth Edison, chairman of Congress local arrangements.



At A.I.Ch.E. Luncheon . . . Nuclear Engineering Division chairman W. K. Davis (AEC) who presided, and Norman Spector, Vitro International, whose address was in the April CEP Scope.

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CHLORINE
PHOSPHORIC ACID
HYDROCHLORIC ACID
BLEACHES
ALUM SOLUTIONS
ANY CORRODENT!

Fibercast

Chemical PIPE and FITTINGS WILL NOT CORRODE!

Fibercast, made from thermosetting reinforced epoxy resins, is long-term pipe economy, particularly where highly corrosive conditions are a constant, costly problem. Frequent replacement of piping used to handle corrosive liquids and gases is no longer necessary when Fibercast is installed.

Fibercast Handling Up to 30% Sulphuric Acid, 8½ Months* . . .
Steel: Replaced every 48 hours!
*. . . and still going strong! (Data on request)

Unretouched cutaway of Fibercast Pipe after 8½ months' service in syphoning sulphuric acid. The pipe was removed only for inspection purposes. There was no failure. FACTS: Syphon was used to empty sump containing up to 30% concentration of sulphuric acid 3 times each 24 hours . . . One end of syphon was immersed in acid solution most of the time . . . Strain test proved Fibercast retained 90% of original strain pattern . . . Inside pipe and elbow showed no measurable loss in wall thickness or appearance. Prior to using Fibercast, it was necessary to replace steel pipe every 48 hours.

Here are a few of the many other Fibercast money-saving advantages:

- Lightness — minimum installation cost
- Easy fabrication on location
- Takes high temperatures
- 18-ft. support span
- 20-ft. joint lengths
- Standard iron pipe O.D.
- Standard A.S.A. flanges

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Send full information on Fibercast Pipe and Fittings.

Particularly for _____ application.

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research news

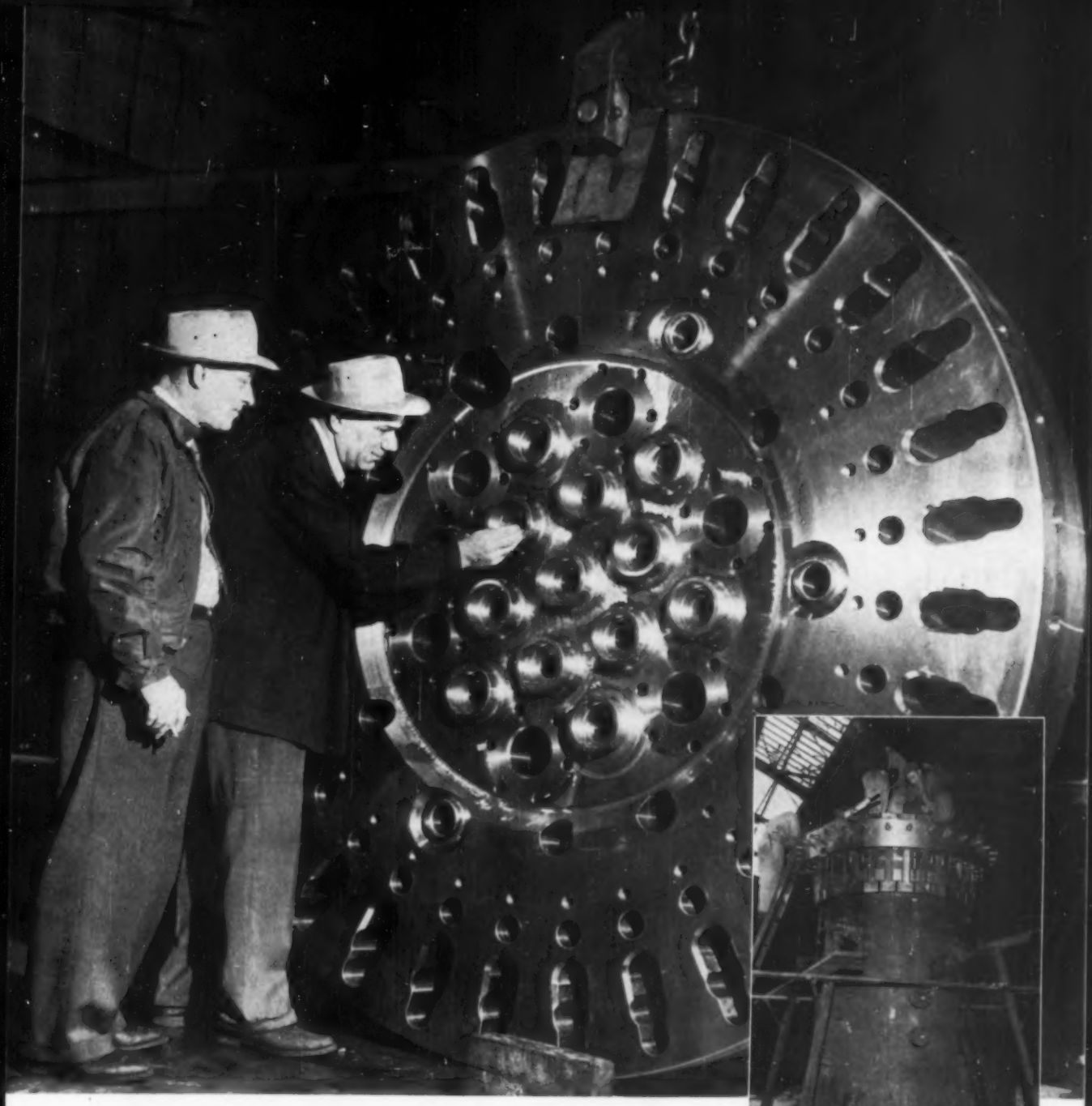
Collaboration in research on improved polymers for plastics and fibers using newly-developed polymerization catalysts, is now underway between National Lead and Celanese. The catalysts are produced by National Lead, are said to be an "important breakthrough" toward successful production of some unique polymers, including radically new types of polypropylene and polystyrene. #

The new laboratory of the Pharmaceutical Division of Geigy Chemical Corp. will include Synthetic Organic Labs, Pharmacologic Labs, and a Biochemistry Dept. Located in Ardsley, N. Y., the new lab will be completed in the near future. #

Warner-Lambert Pharmaceutical Co. has established a Warner-Lambert Research Institute to be located in Morris Plains, N. Y., and designed to consolidate and strengthen the company's major research activities. #

A $3.5 million research center is under construction for Hooker Electrochemical near Niagara Falls, N. Y. #

"Structural adhesives, tailored to meet the wide range of demands created by today's diversified designs in transportation materials, manufacturing processes, architecture, and diverse applications as yet unclassified, will continue to find wide application," said A. G. Battaglia, National Starch Products. With the new adhesives on the market, bond strength, fatigue resistance, assembly time, heat resistance, and other properties of adhesives can be tailored to fit just about any particular application. A prime development has been the lamination of dissimilar materials, such as pictured above, where contact cements have fabricated high pressure laminate to aluminum honeycomb for aircraft bulkheads; polyester fiber glass to phenolic honeycomb; aluminum to aluminum honeycomb; asbestos board to plastic foam to enameled aluminum. #



This pressure vessel had to be designed with a closure that would open in 30 minutes, and withstand 1500 psi, 550F. Made of Type 304 stainless, the top head has 34 connections, of which 19 required exceptionally close tolerances for control rods.

FOR NUCLEAR NEEDS of Knolls Atomic Power Laboratory, M. W. Kellogg was given the exacting assignment of designing and producing a 32½-ton "Proof Test Reactor Pressure Vessel". This was an unusually complex task, because of the quick-opening closure specifications, requiring a head with novel design and extremely close tolerance machining.

FOR NUCLEAR NEEDS of others, Kellogg is supplying the primary coolant stainless piping for two nuclear plants. In addition, Kellogg is equipped to engineer and manufacture heat exchanger equipment for nuclear energy power plants. If these specialized skills suggest a solution to *your* nuclear problems, call Kellogg's Fabricated Products Sales Division.

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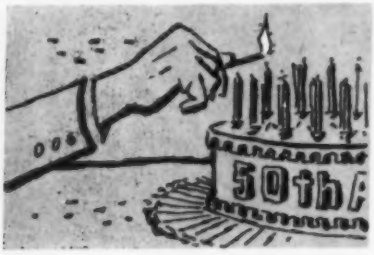
M W KELLOGG

HE LIGHTED THE FIRST CANDLE



. . . and Samuel P. Sadtler, first president of the American Institute of Chemical Engineers, would have been thrilled by the growth and progress of the organization he helped to found in Philadelphia in 1908, and which today has a membership of over 17,000.

Being first was not unusual with Dr. Sadtler, for 17 years earlier he had opened the first American consulting laboratory devoted to the process industries—a business which still bears the name and principles of its founder. Today Samuel P. Sadtler & Son, Inc. is still solving problems, consolidating ideas, supplying new viewpoints, and leading research men into more profitable enterprises. SADTLER services now extend far beyond the consultation stage as its laboratories have also grown with the years.

Thus, as we of Samuel P. Sadtler & Son join in this 50th Anniversary commemoration, we look forward to lighting other candles for other achievements to brighten the world in which we live.

SAMUEL P. SADTLER & SON, INC.
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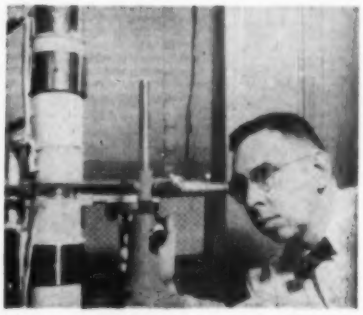
Refining thermally unstable compounds

A new technique, at present in the lab stage, offers strong possibilities as a useful method for refining compounds which are thermally unstable at their melting points.



Whelan examines the molten zone of a gallium arsenide rod during an experiment.

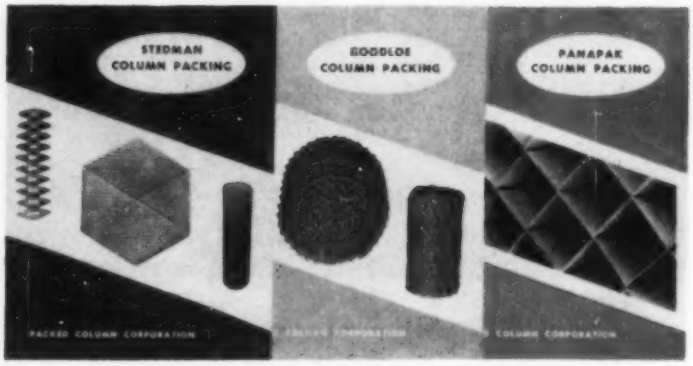
Although the basic experimental work on the new technique was performed on gallium arsenide, and intended to develop a method for growing single crystals of binary semiconductors which decompose on melting, the method should be applicable to a variety of compounds which are thermally unstable at their melting points.

Called the "floating zone method," the technique was described by J. M. Whelan of Bell Telephone Labs. With gallium arsenide, composition of the liquid phase at the melting point is strongly dependent on the partial pressure of arsenic. This is most easily controlled by using a sealed system containing excess arsenic and regulating its minimum temperature. The rate of growth is easily controlled, and spurious nucleation is greatly reduced by the thermal symmetry of the freezing interface.

Other advantages of the method are the reproducibility, regularity of impurity distributions, and the minimization of apparatus contamination.

continued on page 212

Now—for *Low-Cost* plant use



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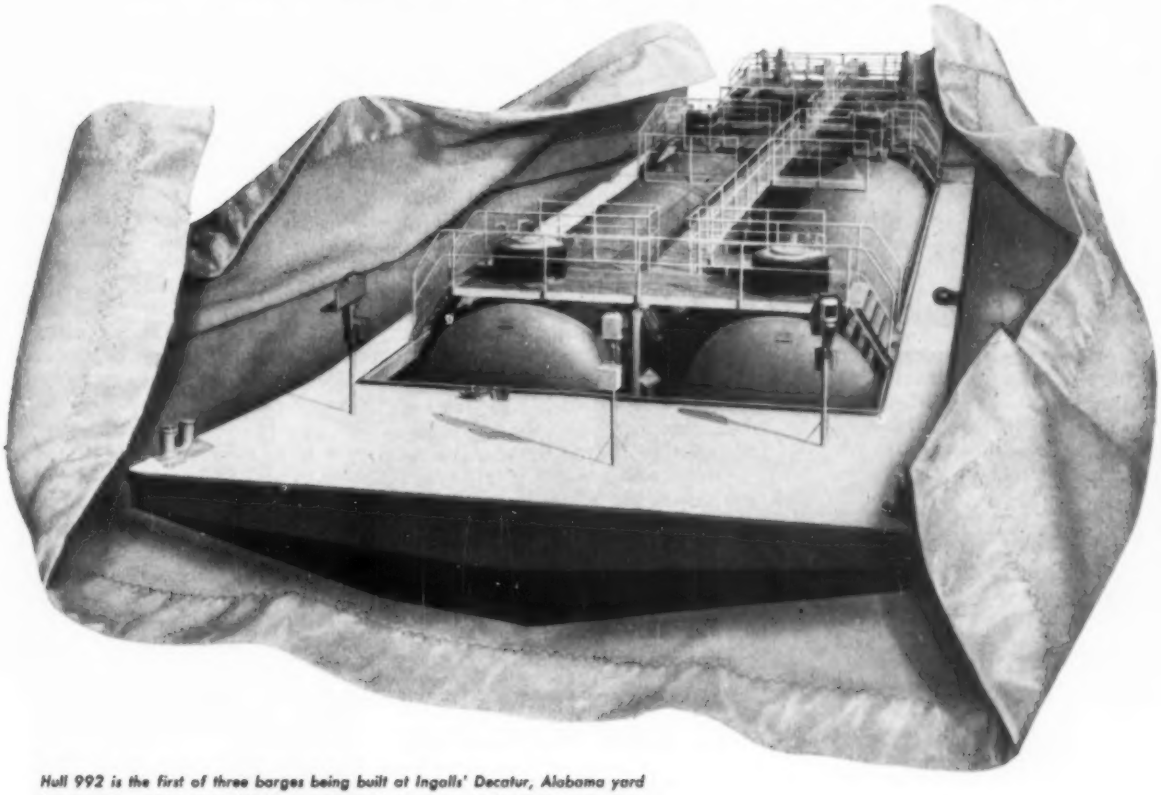
A Column Packing For Every Application

INGALLS wraps an insulating blanket around 1200 tons of caustic soda!



Hull 992 is the first of three barges being built at Ingalls' Decatur, Alabama yard for Westvaco Chlor-Alkali Division of Food Machinery and Chemical Corporation.

Transportation of caustic soda (NaOH) in any quantity is a ticklish task... and hauling 200,000 gallons of it posed a real challenge!

By combining its engineering skills and complete steel fabrication facilities in the construction of *Hull 992*, INGALLS again demonstrated its ability to solve the intricate problems involved in hauling heavy chemicals.

Each 195' barge will carry two tanks, having 200,000 gallon capacity, fabricated by the Birmingham Tank Company, an INGALLS' division. To prevent the cargo from freezing, tanks have built-in steam heating coils and are insulated with four inches of foam glass and rubber-lined to prevent corrosion. Motor-driven pumps are provided for discharging cargo. Tanks can also be emptied by pressurization as they are built to take 50 lb. pressure per square inch. INGALLS' improved bow design on the hulls will reduce towing resistance.

This is just one more example of INGALLS' ability to solve almost any problem involving marine transportation. INGALLS' engineering experience and complete fabrication facilities are at your service for construction or repair at either one of the two yards listed below.

THE INGALLS SHIPBUILDING CORPORATION

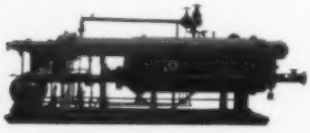
Executive Offices: Birmingham, Alabama

Shipyards: Pascagoula, Mississippi (Two yards on the Gulf); Decatur, Alabama (Largest yard on the Tennessee River)

SPECIAL PROCESS EQUIPMENT for the CHEMICAL INDUSTRY

AIR HEATERS

Outlet temperatures from 200° to 3000°. Available as a complete unit, or burner unit only. Any required pressure can be met with oil or gas or both as fuels.



INERT GAS GENERATORS

Operating reports on units now in service show perfect CO_2, no excess air, no unburned combustibles, wide turndown, and completely dependable flame stability. Specially engineered to your specifications.

The John Zink line of process equipment also includes the famous JZ Smokeless Field Flare, Waste Disposal Units, and more than 50 gas, oil and combination gas and oil burners. Special burners and process equipment designed for your individual application.

JOHN ZINK
COMPANY
4401 S. PEORIA
TULSA, OKLAHOMA

Thermally unstable

from page 210

The relatively large surface-to-volume ratio favors the approach to equilibrium between the liquid and vapor phases. In addition, the small liquid volume minimizes temperature variations in the melt, and the consequent concentration gradients of the principal components.

The technique should be most useful with binary compounds in which only one of the component elements has a considerable vapor pressure at its melting point. The compound must have a high enough electrical conductivity to allow heating by radio frequency induction. The surface tension and density of the molten material must also be such as to support a molten zone during the process.

In the basic floating zone refining technique, a rod is supported vertically. A heat source, for example an induction coil operated at radio frequencies, is moved relative to the rod, melting a liquid zone as it moves. Surface tension supports the liquid zone. Usually by this method, a single crystal can be grown and purification achieved in the zone refining. #

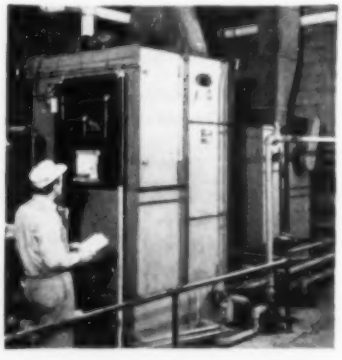
Third major step in the entry of American Smelting and Refining Co. into the asbestos field is a new wing on Asarco's Central Research Laboratories at South Plainfield, N. J. Pending completion of the new wing, Asarco is conducting asbestos research in its present facilities. A leading producer of nonferrous metals, a notoriously changeable industry, Asarco is entering asbestos primarily to gain diversification and a less changeable market picture over the long run. #

A Product Development Laboratory has been opened by the Electro Minerals Division of The Carborundum Co. The lab is designed to meet the increasing demand for technical information on the company's products, such as crude silicon carbide and aluminum oxide, as well as for work on new products. #

A series of new corn starch derivatives is said to be capable of replacing other materials in industrial applications. The new array of corn-chemicals is on the way from Corn Products Refining Co., is said to be based on a "technological change" in the corn crop of the future.

DRY and CLEAN AIR at the RIGHT TEMPERATURE

- to control your product quality
- to protect a critical operation
- to protect apparatus from moisture damage
- to DRY your material or product
- to control packing or storage conditions
- to assure precision in testing or research
- to increase air conditioning capacity



Air Condition by the NIAGARA Method Using HYGROL Liquid Absorbent

This compact method, giving high capacity in small space, removes moisture from air by contact with a liquid in a small spray chamber. The liquid spray contact temperature and the absorbent concentration, factors that are easily and positively controlled, determine exactly the amount of moisture remaining in the air.

Most effective because . . . it removes moisture as a separate function from cooling or heating and so gives a precise result, and always. Niagara machines using liquid contact means of drying air have given over 20 years of service. The apparatus is simple, parts are accessible, controls are trustworthy.

Most reliable because...the absorbent is continuously reconcentrated automatically. No moisture-sensitive instruments are required to control your conditions . . . no solids, salts or solutions of solids are used and there are no corrosive or reactive substances.

Most flexible because...you can obtain any condition at will and hold it as long as you wish in either continuous production, testing or storage.

Write for Bulletins 112 and 131 and complete information on your air conditioning problem.

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Results all in from the Pfaudler AIChE poll

R. E. Smith

R. H. Schwaig

M. L. Hyman

E. W. Neben

We asked these Pfaudler engineers whether their AIChE membership means anything beyond their CEP subscription and a night out once a month.

Their response was quick and unanimous. AIChE membership means, they all say, an "in" on information, firsthand reports of industry trends and progress, a chance to contact and talk with others with similar jobs and related problems, national meetings where the "big picture" is developed, and so on.

Conclusion: AIChE well deserves the accolade it is receiving on its fiftieth anniversary. And, these Pfaudler AIChE national members look forward with favor to the fifty-first.

THE PFAUDLER CO.
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___ copies of: ☐ Bulletin No. B-1608, TYPE DL-DM CHEMICAL PROCESS PUMPS

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PUMP RADIAL LOADS AND STRESSES

Describing the cause, effect, and cure of radial thrust forces on pump impellers, bearings, wear rings, seals, stuffing boxes and the shaft itself, the booklet "MECHANICAL CONSIDERATIONS IN PUMP DESIGN" covers the basic types of process pumps, and discusses the load effects on each. Eight pages, profusely illustrated, this informative reference booklet is now available to engineers and pump buyers. For your copy, send coupon today.

Putting Ideas to Work

FOOD MACHINERY AND CHEMICAL CORPORATION
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Plants: LOS ANGELES 31, CALIFORNIA and INDIANAPOLIS 8, INDIANA

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PEERLESS PUMPS

Schenley Industries, Inc. is taking its first step into the atomic energy field by acquiring a substantial stock interest in Radiation Applications, New York. RAI was one of the organizations recently designated by AEC as equipped to provide gamma irradiation service on a commercial basis. #

Studies are now underway at Hanford aimed at estimating the potential market for fission products as industrial radiation sources, and developing the technology which will permit the efficient recovery of cesium from separations plant waste solutions. At present there are vast quantities of chemical waste containing the radioactive cesium stored at Hanford, and they may some day provide for the industrial-scale irradiation of foods, drugs, chemicals, plastics and other materials. #

A special summer course in Principles of Radioisotope Utilization is being offered by MIT from July 14 through July 25. #

New plant at Oak Ridge makes possible sharp price reductions for five long-lived radioactive isotopes. Generally, the new prices are less than ten percent of those formerly in effect for cesium 137, promethium 147, cerium 144, strontium 90, and technetium 99. The reductions are based on estimated production from the new Multicurie Fission Product Pilot Plant at Oak Ridge, which is scheduled for operation this summer. Depending on the quantity purchased, the new prices per curie range from $1 to $2 for cesium 137, $1.75 to $3.25 for promethium 147, $1 to $2 for cerium 144, and $5 to $10 for strontium 90. Technetium 99 is priced from $80 to $140 per millicurie. #

For the first time, the U.S. is assisting institutions of higher learning in other countries to carry out educational projects designed to further the use of nuclear science for peaceful purposes. The two countries benefitting are Lebanon and Ecuador, and the program is part of the Atoms-For-Peace program. #

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We mine Copper, Sulfur, Iron and Zinc and are basic producers of their chemical derivatives. Our technical know-how and basic position in these minerals is your assurance of exacting quality control, strict uniform consistency and a plentiful supply.

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Samples, specifications and detailed information upon request.

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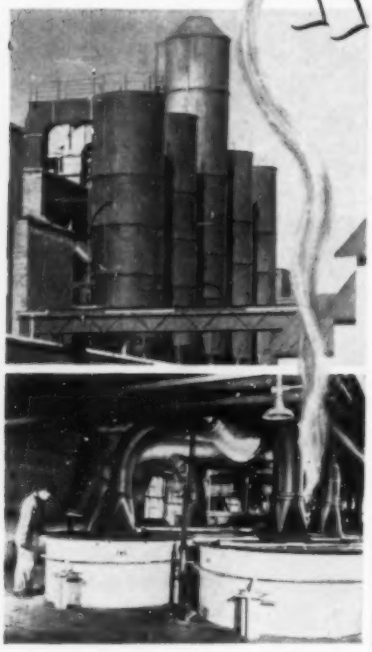
ACID VAPORS Strangled by MULTI-WASH



These vats are giving off harmful acid vapors that could affect workers' efficiency and contaminate air in the neighborhood.

The management of this plant has eliminated these dangerous vapors and the health hazard by using efficient Multi-Wash Collectors.

Each vat is hooded to take away vapors to special Multi-Wash units, lined with acid resistant material to prevent corrosion. There, acid vapors are mixed with a neutralizing liquid to render them harmless.

If your process presents problems in obnoxious vapors, fumes or dusts, contact your local Schneible representative or call us direct.

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To broaden its activities in the nuclear field, Stone & Webster Engineering Corp. has acquired Associated Nucleonics of Garden City, L.I., N.Y. The experienced staff and the laboratory facilities of Associated Nucleonics will supplement Stone & Webster's own Nuclear Projects Division. #

In connection with the chemical processing service available from the AEC to operators of private nuclear reactors, the Commission has specified charges for converting the material resulting from the processing system into forms for which Commission prices have been established. Charges for actual processing are worked out in contracts between the private companies and AEC. But the processing system yields purified nitrate salts of uranium and plutonium, and there is an additional charge for converting these salts into forms for which AEC prices have been established. These additional charges have now been specified.

1) Conversion of purified low-enrichment uranyl nitrate (5% or less by weight of U-235 in total uranium) into uranium hexafluoride: $5.60 per kilogram of contained uranium.

2) Conversion of purified high-enrichment uranyl nitrate (more than 5% by weight of U-235 in total uranium) into uranium hexafluoride: $32 per kilogram of contained uranium.

3) Conversion of purified plutonium nitrate into plutonium metal: $1.50 per gram of contained plutonium. #

The enclosure shell contract for the $29.1 million experimental breeder reactor to be built at AEC's National Reactor Testing Station at Idaho Falls, Idaho, has been awarded to Graver Tank and Manufacturing Co. Graver Tank's contract calls for a one-inch thick steel containment vessel, 80 feet wide and 139 feet high. The work is expected to take 250 days, with the entire EBR-2 project scheduled for completion in 1960. #

The operating power level of AEC's EBWR at Argonne has been increased a second time, has now operated at a level more than three times its original design maximum of 20,000 kilowatts of heat. #

toss your separation problem at us

Materials of different "**densities**" can be separated by **Bauer Specific Gravity Separators.** Widely used applications include the cleaning of food products, such as cereals and peanuts, separating rock from asbestos fibers, corn germ from grits, soybean hulls from meats, shells from cocoa nibs, etc. A complete line of permanent magnetic separators is also available. Send material for testing on commercial sized machines.

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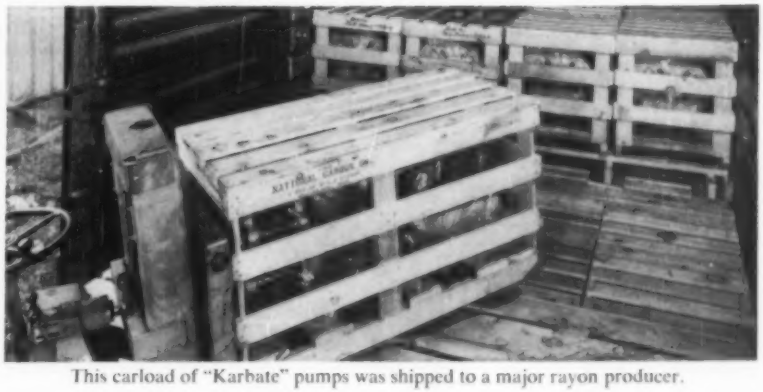
National Carbon representatives expand your engineering force

L. E. BRUGMANN,
SALES ENGINEER

Mr. Brugmann was graduated from Purdue University with a B.S. Degree in Chemical Engineering. For three years he worked in the midwest as a process engineer with a large chemical company. His work covered development of new chemical processes and the improvement of existing processes, both from the technical and economical aspects of the process. It was necessary for Brugmann to know the required equipment thoroughly, to work on the design of new equipment and to draft an economic evaluation of any changes.

Mr. Brugmann has been with National Carbon Company since 1954. His first two years were spent in the Cleveland Office working up Engineering Proposals on incoming inquiries from chemical and allied industries. He has been a field engineer covering the west coast since 1956. Call your National Carbon Sales Engineer today.

"KARBATE" PUMPS HANDLE A WIDE RANGE OF CORROSIVE SERVICES EFFICIENTLY AND ECONOMICALLY



This carload of "Karbate" pumps was shipped to a major rayon producer.

During the past twenty years, "Karbate" impervious graphite pumps have gained an envious performance record corrosion wise. A recent survey on service applications indicates these pumps handle a wide variety of corrosives over a wide temperature range. Some of these solutions are: hydrochloric acid, all concentrations; phosphoric acid — up to 75%; sulphuric acid from 1 to 93%; chlorinated hydrocarbons such as benzene hexachloride, monochloracetic acid, DDT; mixed acids such as nitric-hydrofluoric, sulphuric-hydrofluoric, hydrofluoric-chromic oxide, chromic-nitric hydrofluoric, phosphoric-hydrochloric nitric; chlorinated sodium and potassium chloride brines, ferric chloride; caustic; chlorine saturated water.

The excellent corrosion resistance of "Karbate" pumps permits a given plant to utilize one type pump for all corrosive services. Such a pump standardization means a saving in pump parts inventory, and also means lower maintenance costs due to greater proficiency in handling one type pump.

"KARBATE" PUMPS FEATURE LOW MAINTENANCE COSTS

A rayon manufacturer reports using "Karbate" impervious graphite pumps to handle rayon spin bath solutions. Maintenance costs on each pump were $25.00 the first year and $25.00 the second year — costs on an alloy pump were $25.00 the first year and *$500.00 the second year.*

A major chlorine producer is using "Karbate" impervious graphite pumps to handle chlorinated cell brines. Eighteen pumps are in service. Maintenance costs on the "Karbate" pumps are approximated at $100.00 per pump per year as compared to costs on another non-metallic type pump of *$500.00 per pump per year.*

• • •

"KARBATE" PUMP TABLE OF SIZES AND CAPACITIES

Pump size Suction		Discharge	Motor-Mounted Type F	Frame-Mounted Type C
2	x	1½	29-FAL	1½-CB
3	x	2	19-FAL	2-CA 2-CB
4	x	3	—	3-CA 3-CB
6	x	4	—	4-CA

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COST CUT with *Portable*

LIQUID PROCESSING EQUIPMENT

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Easily moved from job to job, this versatile equipment eliminates the need for numerous, costly fixed installations. Now is the time to prove this in your plant!

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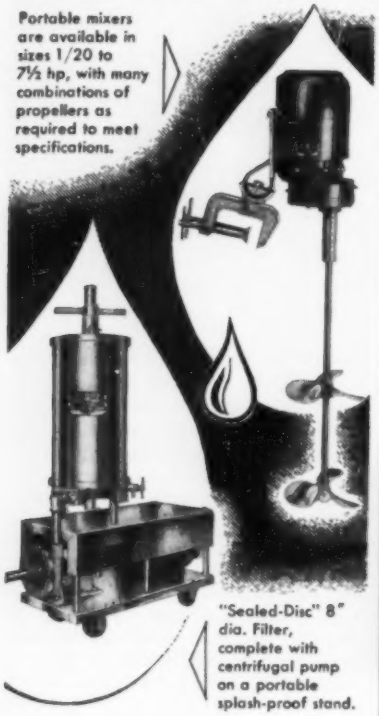

"Sealed-Disc" 8" dia. Filter, complete with centrifugal pump on a portable splash-proof stand.

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future meetings

1958—A.I.Ch.E.

● Lake Charles, La. May 29, 1958. McNeese State College. **One-Day Technical Meeting** co-sponsored by Southwest Sect. of A.I.Ch.E. and Southwest Sect. ACS.

● Berkeley, California. June 19-21, 1958. Dwinelle Hall, Univ. Calif. **1958 Heat Transfer and Fluid Mechanics Institute.** Co-sponsored by **A.I.Ch.E. & other groups.**

● Philadelphia, Pa., June 22-27, 1958. Bellevue-Stratford Hotel. **50th Anniversary Jubilee Meeting of A.I.Ch.E.** See further details on pages 107-114.

● Evanston, Ill., August 18-21, 1958. **A.I.Ch.E.-A.S.M.E. Heat Transfer Conference.** Originally scheduled for Northwestern Univ., has been transferred to the Edgewater Beach Hotel in the same area. Tech. Prog. Chmn.: A. S. Foust, Dept. of Chem. Eng., Lehigh University, Bethlehem, Pa.

● Salt Lake City, Utah, Sept. 21-24, 1958. Hotel Utah. **A.I.Ch. E. National Meeting.** Gen. Chmn.: R. J. McNally, Amer. Smelting and Refining, Salt Lake City, Utah. Tech. Prog. Chmn. and **General Papers:** E. B. Christiansen, Dept. of Chem. Eng., Bldg. 437, Univ. of Utah, Salt Lake City. **Air Pollution**—W. L. Faith, Air Pollution Foundation, 704 S. Spring St., Los Angeles 14, California. **What's New in Liquid Metals Technology**—Chmn. not yet named. **Crystallization**—H. M. Schoen, American Cyanamid Co., 1947 West Main St., Stamford, Conn. and C. S. Grove, Jr., Syracuse Univ., Bldg. D-6, Collendale, Syracuse 10, N. Y. **Foams and Froths**—J. Louis York, Dept. of Chemical Engineering, Univ. of Mich., Ann Arbor, Mich. **Ethylene**—Hermann C. Schutt, 201 Devonshire Street, Boston, Mass. **Polar-Nonpolar Thermodynamics**—J. M. Smith, Dept. of Chem. Eng., Northwestern Univ., Evanston, Ill. **Petroleum Substitutes**—J. H. Hirsch, Gulf R&D Co., P. O. Drawer 2038, Pittsburgh 30, Pa. **Centrifugation**—J. O. Maloney, Univ. of Kansas, Lawrence, Kansas. **Intermountain Industries**—W. C. Bauer, Intermountain Chem. Corp., Box 872, Green River, Wyoming. **High Temperature Chemical Kinetics and Transport Phenomena**—W. R. Marshall, Univ. of Wisconsin, Madison, Wis. **Dry Classification of Solids**—D. W. Oakley, Metal and Thermit Corp., 100 Park Ave., New York, N. Y. **Safety in Air and Ammonia Plants**—N. H. Walton, Atlantic Refining, 3144 Passyunk Ave., Philadelphia 1, Pa. **Improved Utilization of Technical Manpower**—J. F. Cheely, Ethyl Corp., Box 341, Baton Rouge, La. **Petroleum Refining**—L. W. Russum, Standard Oil Co. (Indiana), Whiting, Ind. **Hydrometallurgy-Chemistry of Solvent Extraction**—G. H. Beyer, Chem. Eng. Dept., U. of Mo., Columbia, Mo. **Alternate Energy Sources**—H. F. Nolting, Std. Oil Co. (Ind.), 2400 New York Ave., Whiting, Ind.
Deadline for papers, May 21, 1958.

continued on page 220

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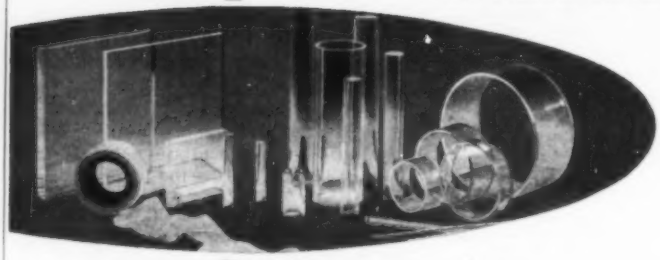

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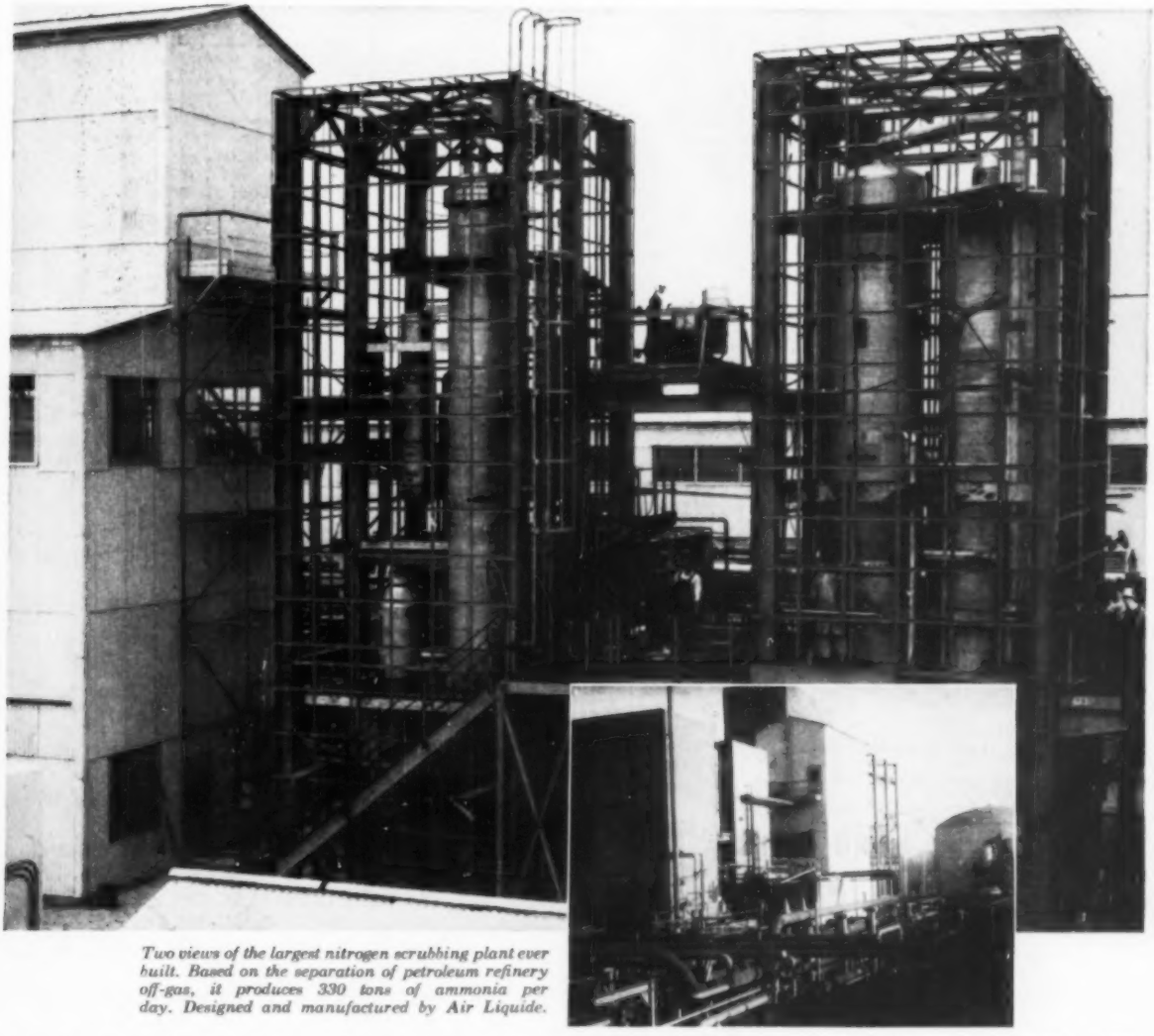

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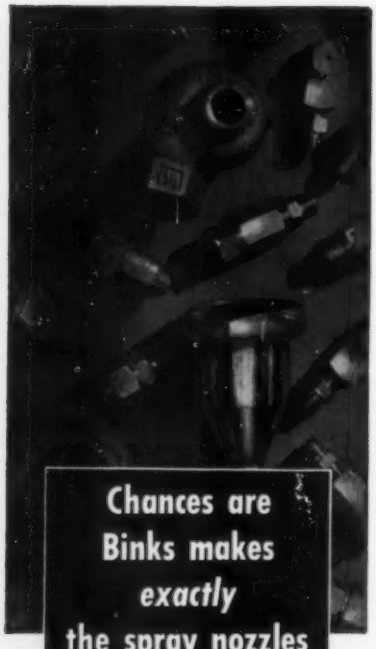

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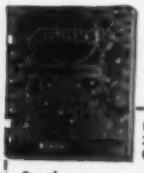

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future meetings

from page 218

• Cincinnati, Ohio, December 7-10, 1958. Netherland Plaza Hotel. **A.I.Ch.E. Annual Meeting.** Genl. Mtg. Chmn.: T. B. Wiehe, Schenley International. Tech. Prog. Chmn.: A. C. Brown, Emery Industries, Inc. June & Long Sts., Ivorydale, Ohio. **Pollution Control by In-Plant Measures**—C. Fred Gurham, Dept. of Chem. Eng., Michigan State U., East Lansing, Michigan. **A.I.Ch.E. Research on Bubble Cap Tray Efficiency**—W. C. Schreiner, M. W. Kellogg Co., 711 Third Ave., New York 17, N. Y. **High-Speed Photography in Chemical Engineering**—J. W. Westwater, William Albert Noyes Laboratory, Univ. of Illinois, Urbana, Ill. **Kinetics & Rate Processes**—H. E. Hoelscher, Dept. of Chem. Eng., Johns Hopkins Univ., Baltimore 18, Md. **Reprocessing of Fluid Reactor Fuels**—O. E. Dwyer, Chem. Eng. Div., Brookhaven National Laboratory, Upton, L. I., N. Y. **The Application of Computers to Heat and Mass Transfer Problems**—J. M. Smith, Northwestern Univ., Evanston, Ill. **Low Temperature Processing**—C. McKinley, Air Products, Inc., Allentown, Pa. **Scale-up from Pilot Plant to Plant**—D. B. Coghlan, Foote Research and Development Laboratories, Berwyn, Pa., R. A. Schulze, DuPont Chambers Works, Jackson Labs., Penns Grove, N. J. **Guideposts in Long Range Planning**—H. E. Wessel, Virginia-Carolina Chemical Corp., 401 Main St., Richmond, Va. **Processing of Irradiated Fuels—A Challenge for the Future**—J. L. Schwennesen, A.E.C., P.O. Box 1221, Idaho Falls, Idaho. **Spray Mechanisms**—J. F. Tourtellotte, Swenson Evaporator Co., 18505 James Couzens Highway, Detroit, Mich. **Developments in Synthetic Rubbers**—C. C. Winding, Cornell Univ., Ithaca, N. Y. **Air-Cooled Heat Exchange**—W. W. Akers, Dept. of Chem. Eng., Rice Institute, Houston, Texas. **Education in Process Control**—T. J. Williams, Monsanto Chem. Co., 1700 S. Second St., St. Louis 4, Mo. **General Papers**—W. M. Licht, Dept. of Chem. Eng., Univ. of Cincinnati, Cinn., Ohio.
Deadline for papers: August 7, 1958.

1958 MEETINGS—NON-A.I.CH.E

• Philadelphia, Pa. May 25-29, 1958. Sheraton Hotel. Annual Meeting Air Pollution Control Assoc.

• Brussels, Belgium, May 28-29, 1958, and Frankfurt am Main, West Germany, May 31-June 8, 1958. **ACHEMA Exhibition:** More than 820 exhibitors from 13 countries will fill 14 exhibition halls. **ACHEMA Congress:** Lecture series, films, plus technical group sessions. **European Federation of Chem. Eng. Congress:** will include sessions on Works and Matls. Techniques, Planning, etc. **European Federation of Corrosion Congress:** Nature of corros. and protective measures.

• New London, New Hampton, and Meriden (all), New Hampshire. June 9-Aug. 29, 1958. **Gordon Research Conferences:** scheduled lectures & discussion groups across frontiers of science. For information: W.

continued on page 222

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Second National Heat Transfer Conference and Exhibit

Sponsored by the American Institute of Chemical Engineers
and the American Society of Mechanical Engineers

Invitation to exhibit

Edgewater Beach Hotel
Chicago, Illinois

August 18 - 20, 1958

The Conference will begin on Sunday, August 17, with registration of the delegates, exhibitors, etc. The Exhibit, however, will not be open to the public until 9:00 a.m. Monday, August 18.

Here is the major event of the year in heat transfer! The same high quality engineer who came to the Penn State Conference last year will be in Chicago this August. We expect three solid days of conferences by top-notch people in the heat-transfer area —giving you an unparalleled opportunity to tell your story to the key men who buy and specify heat-transfer equipment—the engineers of the American Society of Mechanical Engineers and the American Institute of Chemical Engineers.

The Conference this year will feature the industrial and practical application of heat transfer and it is expected that two technical sessions will be running morning and afternoon during the three days of the Conference.

Those of you who have exhibited at The Edgewater Beach Hotel before will realize the advantages of the unity the hotel will give to the Exhibit. The entire hotel is comfortably air-conditioned, it has an outdoor swimming pool, and there is a nearby golf course.

Reserve your space early! Space will be assigned strictly in the order applications are received, on a first-choice first-served basis. Write, wire or telephone for complete details and application blanks.

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future meetings

from page 220

George Parks, Dept. of Chem., Univ. of Rhode Is., Kingston, R. I., or at Colby Jr. Coll., New London, N. H., from June 9 through Aug. 29.

• London (Olympia), England, June 18-28, 1958. **Chemical and Petroleum Exhibition,** sponsored by British Chemical Plant Manufacturers Association and Council of British Manufacturers of Petroleum Equipment. Symposium on **The Organization of Chemical Engineering Projects,** organized by the Institution of Chemical Engineers and the Institute of Petroleum (4 sessions).

• Boston, Mass., June 22-27, 1958. Hotels Statler & Sheraton-Plaza. ASTM Annual Meeting.

• Geneva, Switzerland, Sept. 1-13, 1958. **Second International Conference on the Peaceful Uses of Atomic Energy.**

1959 MEETINGS—A.I.CH.E.

• Atlantic City, N. J., March 15-18, 1959. **A.I.Ch.E. National Meeting.** Chalfonte Haddon Hall Hotel. Gen. Chmn.: J. D. Stett, Dept. Mech. Eng., Rutgers Univ., New Brunswick, N. J. Tech. Prog. Chmn.: N. Morash, Nat'l. Lead Co., P.O. Box 58, So. Amboy, N. J. **Recent Advances in Plastic Materials of Construction**—M. F. Cigliotti, Monsanto Chem. Co., Plastic Div., Springfield, Mass. **Business & Technology**—J. Happel, NYU, University Hgts., New York, N. Y. **Laboratory and Pilot Plant Techniques**—G. W. Blum, Goodyear Tire & Rubber Co., Akron, Ohio. **Missiles & Rockets**—G. C. Szego, Gen. Elect., Aircraft & Gas Turbine Div., Cinn. 15, Ohio. **General Papers** (2 sessions), J. Jaffe, Newark Coll. of Eng., 367 High St., Newark 2, N. J. and E. C. Johnson, Dept. of Chem. Eng., Princeton U., Princeton, N. J. **Computer Control of Processing Units**—D. M. Boyd, Universal Oil Prods., 30 Algonquin Rd., Des Plaines, Ill. **Startup of New Chemical Plants**—M. L. Nadler, DuPont, Penns Grove, N. J. **Care and Feeding of Executives**—J. S. Wilson, Heidrick & Struggles, 20 No. Wacker Dr., Chicago 16, Ill. **Mechanics of Fluid-Particle Systems**—S. K. Friedlander, Columbia U., New York 27, N. Y. **Process Data & Design Methods for Nuclear Fuel Recovery**—C. E. Stevenson, Rsch. Dir., P.O. Box 1259, Idaho Falls, Idaho. **Thermodynamics of Phase Equilibria**—E. M. Amick, Jr., Chem. Eng. Dept., Columbia U., New York 27, N. Y. **Market Research & the Chemical Engineer**—William Copulski, Grace R&D Co., 3 Hanover Sq., New York 4, N. Y. **Thermal Stability of Fuels for Jet and Rocket Service**—C. J. Marsel, NYU, Univ. Heights, New York, N. Y.
Deadline for papers: November 16, 1958.

• Cleveland, Ohio, April, 1959. **7th Conf. on Hot Labs. & Equip. A.I.Ch.E. and others.** Prog. Chmn.: L. G. Stang, Jr. Brookhaven Nat'l. Lab., Upton, L. I., N. Y. Abstracts for papers due Sept. 15, 1958.

continued on page 224

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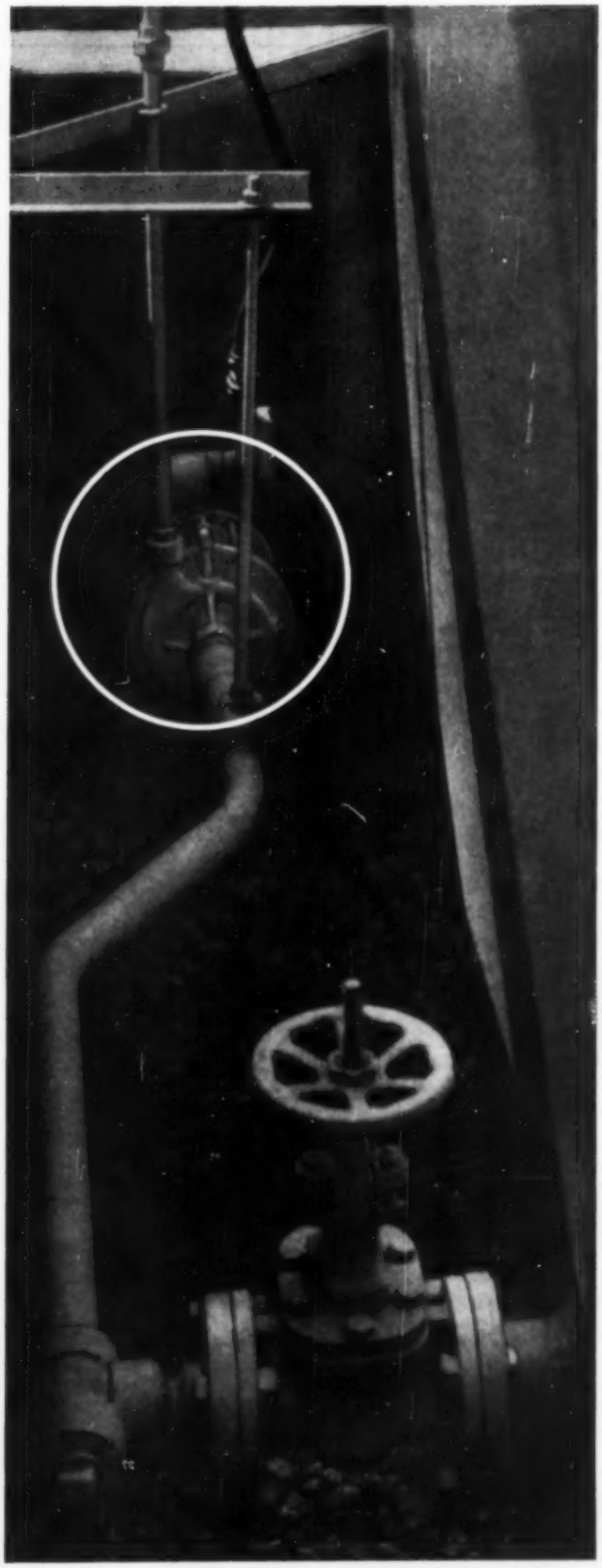

Chempump saves $1000 a year in maintenance costs

handling sulfuric acid at laminates plant of Panelyte Division, St. Regis Paper Co.

This *Chempump* is part of the phenol recovery process at the Trenton, N. J. plant of St. Regis Paper Company's Panelyte Division. The pump operates intermittently for about ten minutes, three times during each shift of a three-shift day. Since its installation, in July 1955, it has been continually on the job, moving about a thousand pounds of 66° Baumé sulfuric acid every day. No maintenance has been performed on the pump since it was installed—not even a bearing inspection. The plant's maintenance superintendent states that this *Chempump* has saved more than $1000 in maintenance expense during its first year of operation.

Originally, a stuffing box pump was used in this service. Leakage corroded the pump frame and base plate to such an extent that the pump had to be replaced three times. Acid which leaked from the stuffing box also ate away the concrete mounting block.

Leakage problems ended with installation of a *Chempump*. *Chempump can't* leak—in or out—because it has no seals, no stuffing box, no packing. External lubrication is never needed, because the bearings are constantly lubricated by the pumped fluid itself.

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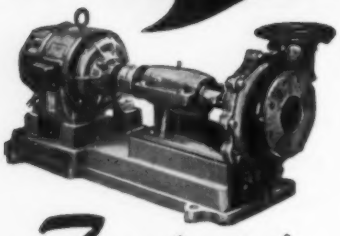

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Write for Bulletin No. 107

FREDERICK PUMPS

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future meetings

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● Kansas City, Missouri, May 17-20, 1959. Hotel Muehlebach. **A.I.Ch.E. National Meeting.** Gen. Chmn.: F. C. Fowler, Consulting Chem. Engr., 7515 Troost Ave., Kansas City, Mo. Tech. Prog. Chmn.: Fred Kurata, Chem. Eng. Dept., Univ of Kansas, Lawrence, Kansas. **Reaction Kinetics**—R. R. White, Dept. of Chem. Eng., Univ. of Michigan, Ann Arbor, Mich. **How to Become a More Proficient Technical Engineer. Heavy Chemicals**—N. J. Ehlers, Columbia-Southern Chem. Corp., 1 Gateway Center, Pitts. 22, Pa. **Petrochemicals**—G. E. Montes, Nat'l. Petrochemical Corp., Tuscola, Ill. **International Licensing and Collaboration**—R. Landau, Scientific Design Co., 2 Park Ave., New York, N. Y. **General Papers** (2 sessions). J. O. Maloney, Univ. of Kansas, Lawrence, Kan. and Merk Hobson, Univ. of Nebraska, Lincoln, Nebr. **Non-Equilibrium Fluid Mechanics**—M. J. Rzasa, Cities Service Res. Lab., P. O. Box 402, Cranbury, N. J. **Multiphase Flow in Pipes and Annuli**—C. S. Kuhn, Magnolia Petroleum Co., 907 Thomasson Dr., Dallas Tex. **Thermodynamics of Jet & Rocket Propulsion**—G. C. Szego, Gen. Elect. Aircraft & Gas Turbine Div., Cinn. 15, Ohio. **Computers and Pipelines**—R. L. McIntire, The Datics Corp., 600 Camp Bowie Blvd., Fort Worth, Texas
Deadline for papers: January 17, 1959.

● St. Paul, Minn., Sept. 27-30, 1959. Hotel St. Paul. **A.I.Ch.E. National Meeting.** Gen. Chmn.: W. M. Podas, Asst. Rsch. Dir., Economics Lab., Guardian Bldg., St. Paul, Minn. Tech Prog. Chmn.: A. J. Madden, Jr., Univ. of Minn.

● San Francisco, Calif., December 6-10, 1959. **A.I.Ch.E. Annual Meeting.** Gen. Chmn.: Mott Souders, Jr., Shell Development Co., 4560 Horton St., Emeryville 8, Calif. Tech. Prog. Chmn.: C. R. Wilke, Div. of Chem. Eng., Univ. of Calif., Berkeley, Calif. **Process Dynamics**—E. F. Johnson, Dept. of Chem. Eng., Princeton Univ., N. J. **Secondary Oil Recovery Methods; New Oil Sources—Shale, Gilsonite, Tar Sands; Financing in the Chemical Industry; Raw Materials for the Chemical Industry; Turbulence and Turbulent Mixing; High Temperature: Thermodynamics, Reactions, Kinetics; Devices, and Materials-Operations Research; Electrochemical Engineering-Process Design; Fundamental Aspects of Chemical Engineering in the Pulp and Paper Industry.**
Deadline for papers: August 6, 1959.

1960 MEETINGS—A.I.CH.E.

● Atlanta, Georgia, February 21-24, 1960. **A.I.Ch.E. National Meeting.** Tech. Prog. Chmn.: Fred Bellinger, Ga. Inst. of Techn., 225 North Ave., N.W., Atlanta 13, Ga.

Unscheduled Symposia

Correspondence on proposed papers is invited. Address communications to the Program Chairman listed with each symposium below.

Size Reduction: Edgar L. Piret, Chem. Eng. Dept., U. of Minnesota, Minneapolis 14, Minn.

continued on page 228

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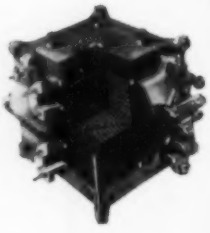

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1957—Fighting the elements to see 26th Chemical Exposition.

Above and below: Recent Exhibits get close attention.

In the uncertain days of war-clouded 1915, the Exposition of Chemical Industries was born. Outbreak of World War I found America and her Allies woefully dependent upon German supplies of dyes, pharmaceuticals, organic chemicals, and vital processing equipment. An acute need was apparent for a definite clearing-house of information on available chemicals and apparatus to help develop American Chemical progress to meet the sudden emergency situation. Why not a chemical exposition? It would provide the much-needed common meeting-ground for interchange of existing knowledge, equipment and materials. It would serve also to awaken the nation to the dangers of dependence upon foreign sources of supply.

With the support of a group of prominent chemists, the First Chemical Exposition became a reality. Need for the exposition was thus definitely established, and ensuing years saw it grow in importance and stature—from 83 to 437 exhibitors within the first 7 years! American business came, saw, and invested—no longer was there any question as to the necessity for a completely self-contained American Chemical Industry.

1915 is now 43 years past. The 26th Exposition, held in 1957, was the largest in its history, reflecting the ever expanding nature of the chemical process industries. With new horizons to be faced in the future, chemists and chemical engineers will again be looking to this exposition—the Chemical Industries Exposition—for new materials and equipment, more efficient techniques and improved product performance.

EXPOSITION OF CHEMICAL INDUSTRIES

1915 RAW MATERIALS — MACHINERY — PRODUCTS 1958

The 27th Exposition will be held at New York Coliseum, November 30th to December 4, 1959

Management: International Exposition Company, 480 Lexington Avenue, New York 17, N. Y.

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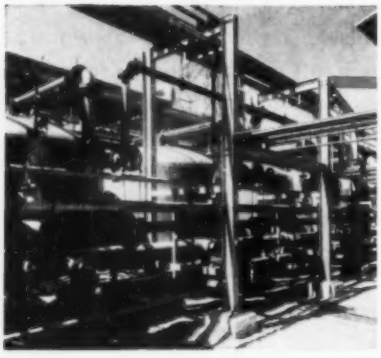

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MANY APPLICATIONS

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future meetings

form page 224

Chemical Engineering Process Dynamics as They Affect Automatic Control: David M. Boyd, 315 Ridge Ave., Clarendon Hills, Ill.

The Threatened Imbalance Between Chlorine and Alkali in American Chemical Industry: Zola G. Deutsch, Deutsch & Loonam, 70 E. 45th St., New York City 17.

Financing for the Chemical Industry: Bernard Stott, First National City Bank of New York City, New York, N. Y.

Chemical Engineers in Chemical Industry Management: T. P. Forbath, American Cyanamid Co., 488 Madison Ave., New York, N. Y.

Training on the Job for Industry: John Happel, Dept. of Chem. Eng., N. Y. University, University Heights, New York 53, N. Y.

Properties of Liquids: S. E. Isakoff, Engineering Research Laboratory, Du Pont, Wilmington, Del.

Preparation of Catalytic Cracking Charge Stocks and Quality Criteria Therefor: Wheaton W. Kraft, Lummus Co., 385 Madison Ave., New York 17, N. Y.

Solar Energy Research: J. A. Duffie, Director of Solar Energy Laboratory, Univ. of Wisconsin, Madison, Wis.

In addition to the above, the following symposia in the management area are available from J. Happel, Dept. of Chem. Eng., New York Univ., University Heights, New York 23, N. Y.:

• Market Research • Financing • Growth of the Chemical Industry • Distribution between Dividends and Growth in Financing • Stock Market Analysis for Chemical Companies • International Growth • Filling Vacancies in Top Management • Duties of a Good Director • Where Chemical Engineers Go After Graduation • Long Term Planning.

Author Information

Procedure in submitting papers:

1. Obtain four copies of "Proposal to present a paper before the A.I.Ch.E." plus one copy of "Guide to Authors" from Secretary, A.I.Ch.E., 25 West 45th St., New York 36, N. Y.

2. Send one copy of completed form to Technical Program Chairman for meeting selected from above list.

3. Send another copy to H. D. Guthrie, Shell Oil Co., 50 West 50 Street, New York, 20, N. Y. (Asst. Chmn, Program Comm.)

4. Send third copy to Editor, Chemical Engineering Progress, 25 West 45th St., New York 36, N. Y. Paper will automatically be considered for possible publication in A.I.Ch.E. Journal.

5. If desired to present paper in a selected symposium, send fourth copy to chairman of the symposium.

6. Prepare five copies of manuscript. Send one copy each to Symposium chairman, Technical Program chairman, or both copies to latter if no symposium is involved. Other three copies should be sent to Editor C.E.P. Presentation at meeting offers no guarantee of acceptance for publication.

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of VACUUM SYSTEMS
with this "AERO" (air-cooled)
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Air-vapor subcooling reduces mixture evacuated from the system, saving in the operation of steam ejector or vacuum pump.

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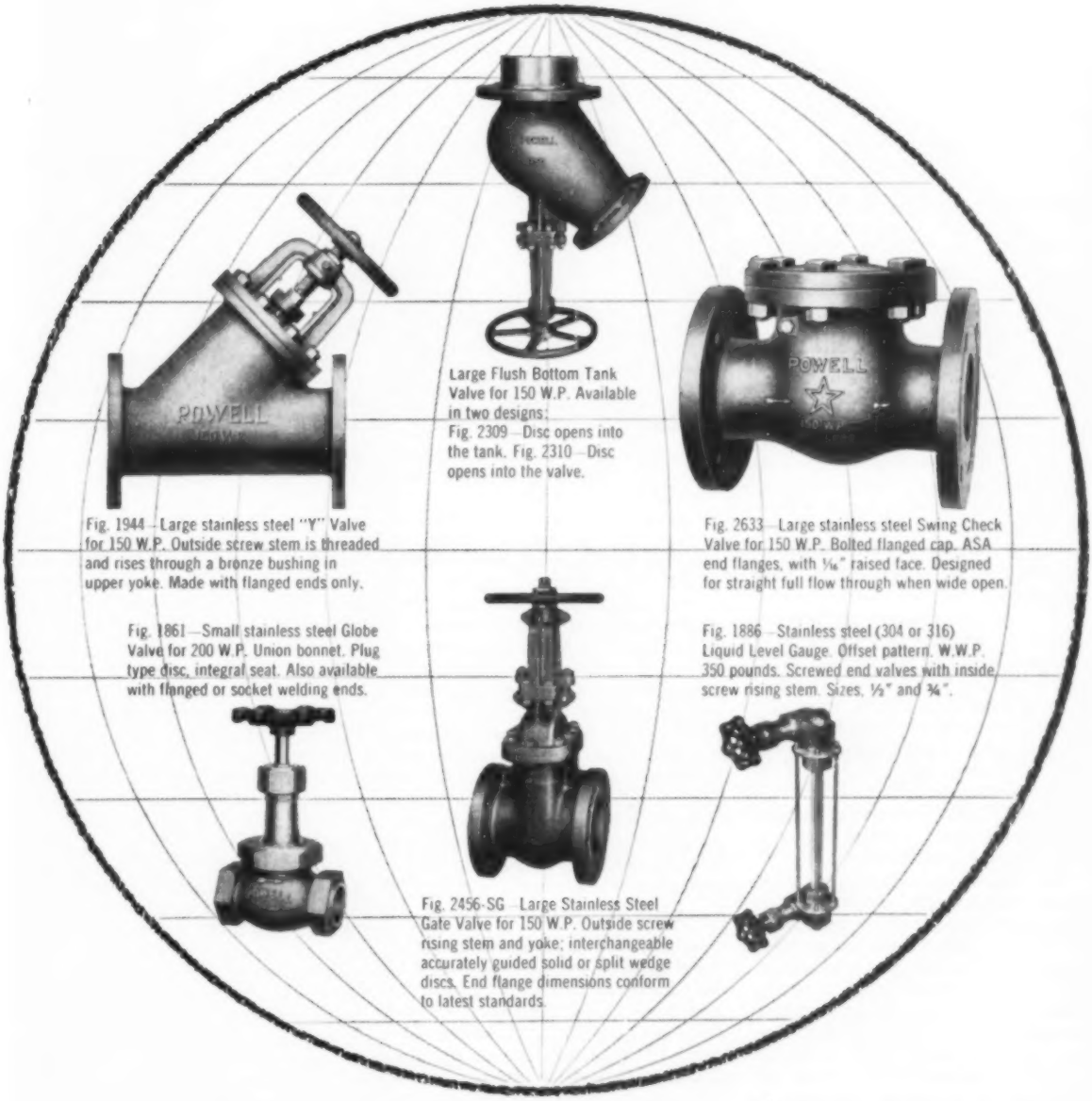

Large Flush Bottom Tank Valve for 150 W.P. Available in two designs: Fig. 2309—Disc opens into the tank. Fig. 2310—Disc opens into the valve.

Fig. 1944—Large stainless steel "Y" Valve for 150 W.P. Outside screw stem is threaded and rises through a bronze bushing in upper yoke. Made with flanged ends only.

Fig. 2633—Large stainless steel Swing Check Valve for 150 W.P. Bolted flanged cap. ASA end flanges, with 1/16" raised face. Designed for straight full flow through when wide open.

Fig. 1861—Small stainless steel Globe Valve for 200 W.P. Union bonnet. Plug type disc, integral seat. Also available with flanged or socket welding ends.

Fig. 1886—Stainless steel (304 or 316) Liquid Level Gauge. Offset pattern. W.W.P. 350 pounds. Screwed end valves with inside screw rising stem. Sizes, ½" and ¾".

Fig. 2456-SG—Large Stainless Steel Gate Valve for 150 W.P. Outside screw rising stem and yoke; interchangeable accurately guided solid or split wedge discs. End flange dimensions conform to latest standards.

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Education, technical developments, marketing–highlight section meetings

A panel discussion on Advice to Junior Engineers was the feature of **Pittsburgh's** *(V. N. Hurd)* annual student night. A review of energy sources of the past, and the need to supplement these in the future, was the keynote address by C. H. Weaver, VP of Westinghouse's new Atomic Power Division. He discussed the basic principles of obtaining power from the atom, some of the typical problems encountered (particularly those of interest to the chemical engineer), the human resources needed to solve these problems, and the outlook for nuclear power in the future. The panel members, with their respective fields, were: G. J. Esselsen, III, Sales Mgr., Activated Carbon Div., Pitts. Coke & Chem. Co. Technical Sales; J. A. Patterson, Pres., Chempro, Inc., Consulting; H. W. Rahn, Coordinator of R&D, Columbia-Southern, Research & Development; and P. Siecke, Dir., of Process Design, Gulf Oil Corp., Manufacturing. Awards were made to senior students for proficiency in reporting results of work in unit operations.

Undergraduates in engineering courses in our universities will study more mathematics and modern physics, according to George Marston, Dean of Engineering at the University of Massachusetts. In a talk given to a joint meeting of the Engineering Society of Western Mass. and the **Western Massachusetts** section of A.I.Ch.E. *(Richard E. Delacretaz)* in January, Marston discussed current trends in engineering education.

The increased emphasis on mathematics and modern physics will, in some instances, be at the expense of classical physics and design-type courses; the latter being displaced towards the graduate level of study. Current trends include an increased integration of material, where numerous separate courses would be consolidated into fewer courses. There will probably be decreased allowance in the future, of the Advanced ROTC course as credit towards the engineering degree.

Future engineering calls for increased stress in the fundamental sciences, and more time devoted to the superior student. Students will be made more individually responsible for their education, and more of them will go on to graduate work. Marston predicted that the industry of the future will assume more responsibility towards the continuing of the employee's education. The technical institutes, with their two-year programs, will become increasingly important sources of technical personnel–catering to students whose scientific interests are along more "practical" lines.

Because of the increased emphasis on mathematics and fundamental sciences, the future B.S. graduate in engineering may be of less initial value to an employer. However, the graduate's potential for growth and development on the job should be greater.

Ray Ewell reports on Russia to National Capital Section. At right, R. L. Tuve, chmn., and at left, F. C. Moesel, vice-chmn.

Chromatography

A brief history of the development of gas chromatography was presented to *the* **Charleston Section** *(L. L. Cavender)* by Charles Fellows of Union Carbide Chemicals in November. Currently, continuous chromatographic analysis employs an elution technique, of which there are two methods: gas absorption, and gas-liquid partition. The essential elements of the apparatus are the chromatographic column, carrier gas, flow controller, detector, temperature control, and a sampler induction system. The heart of the instrument is the absorption column. Determination of column parameters is an art rather than a science; the determination is made by trial and error. Plant stream analyzers must be tailored to use. Two demands are made on these instruments; accuracy equivalent to lab results and low cost with ease of maintenance. Applications are widely varied, and where applicable, gas chromatography is fast, accurate and easy to use. In some applications, a column life of 10-12 months has been attained.

A double-barreled broadside was delivered to the March luncheon meeting of the **National Capital Section** by Raymond H. Ewell, Vice Chancelor of Research, at the University of Buffalo. Having returned from a three-week tour around Russia, he gave his own conclusions about what he saw there. Although his information agreed fairly well with what has already been published, his observations did differ in some respects. Drawing on his extensive background as a consultant on industrial research under the auspices of the Ford Foundation, Ewell also described the development of a national research program for India.

Petroleum fuels

An insight into the cars and fuels of the future was given to the **Southern California** section *(S. Miner)* at its February meeting by Gregory J. Serazusa, regional Lab. Mgr. of DuPont,

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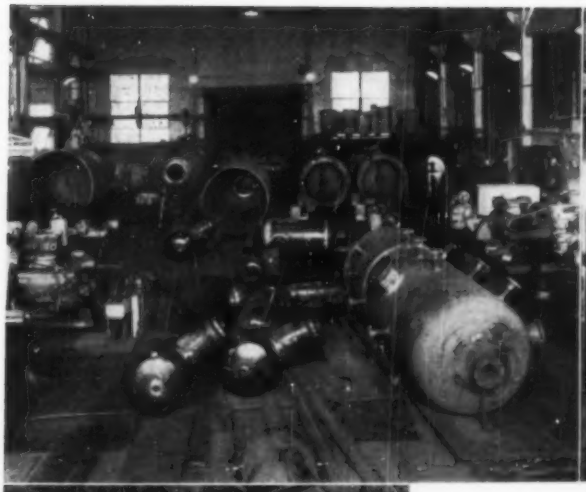

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and Peter Kyropoulos of GM's Technical Development section.

The changes in petroleum processing brought about by the rapid increase in engine horse-power and compression ratio over the last eight years were discussed by Serazusa. Increased compression ratios and horsepower have increased the problems of engine deposits, pre-ignition, and spark plug fouling. The processes of the future will probably include isomerization, thermal cracking of catalytic reformate, and extraction of aromatics. He said that the aromatic products of these processes will probably constitute the back end of future gasolines. Future gasolines will probably be totally synthetic, and contain additives to reduce pre-ignition, deposits on spark plugs, gum formation, and to prevent carburetor-icing and corrosion.

Better fuel mileage can be obtained by the matching of motors and transmissions, claimed Kyropoulos as he spoke on automotive plants. Fuel consumption is also decreased by raising the compression ratio, and mechanical octane numbers can be designed into combustion chambers.

In discussing gas turbines, Kyropoulos stated that the size of the turbine increases relatively slowly with increase in power requirement, and that small turbines "take a beating" efficiency-wise. The most probable use of gas turbines will be in trucks—not automobiles—where large power plants are needed. By emphasis, he added, "Don't look for miniature power plants. They are not to be had!"

In pursuing the subject of free piston engines, he claimed that all kinds of fuel could be used in these because hot gases from the free piston engine run a power turbine.

Titanium—Jets

Titanium purification and processing was the timely subject of Ward M. Minkler, Titanium Metals Corp., at the **East Tennessee** *(J. C. Umberger)* March meeting. Titanium's use in aircraft, because of the high temperatures encountered beyond the speed of sound, was cited. Among the factors which make titanium an important metal are: its density, corrosion resistance, and abundance. The

continued on page 232

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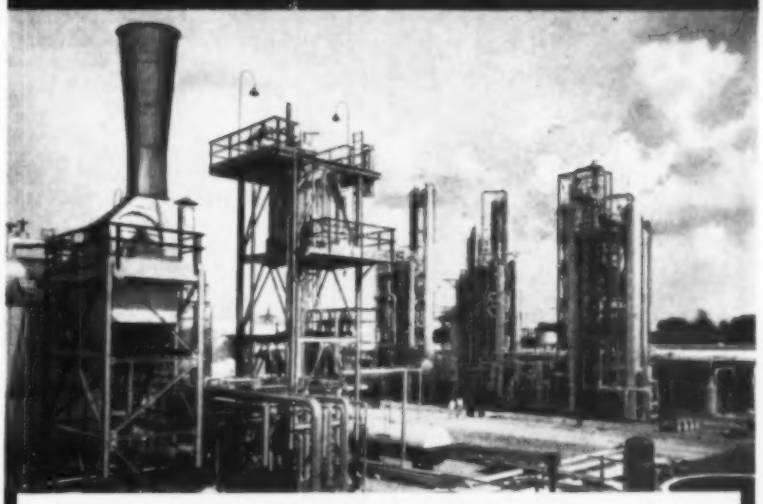

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Anhydrous Ammonia	Food Machinery & Chemical Corp. (Westvaco Chlor-Alkali Division)	South Charleston, West Virginia
Phthalic Anhydride	Pittsburgh Coke & Chemical Co.	Neville Island, Pa.
Epon Resins	Shell Chemical Corp.	Houston, Texas
Bisphenol	Shell Chemical Corp.	Houston, Texas
Tetramer, Cumene, Phenol-Acetone	Societe des Chimiques des Derives du Petrole	Antwerp, Belgium
Sulfuric Acid	Inland Chemicals Canada Ltd.	Fort Saskatchewan, Alberta, Canada
Ethylene Oxide-Glycol	Calcasieu Chemical Corp.	Lake Charles, La.
Ethylene	Petroleum Chemicals, Inc.	Lake Charles, La.
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use of titanium in the chemical process industries was then discussed. In this application it is important for its corrosion resistance up to 1000°F. Titanium is 44% lighter than steel, its service life is ten times longer, and it can be produced in strength equal to, or greater than, steel. Its fabrication methods are similar to those used for stainless steels.

The price of sponge titanium has been gradually reduced to about half its 1954 cost. The fact that production capacity in the past year has increased more than demand, has contributed to this. Minkler has predicted that the price of titanium will soon be in the range of the Hastelloys and austenitic stainless steels.

Jet ejectors and their industrial application intrigued the **New Haven Section** *(Herbert Borsvold)* in February. C. G. Blatchley of Schutte and Koerting explained the various basic types of jet diffusers; such as liquid-liquid, gas-liquid, etc. and gave examples of their application. He illustrated the effect of the properties of the gas being handled on the jet, and showed typical characteristic curves for various jet ejectors.

Blatchley explained the design and performance of the two-stage jet, and compared this with a mechanical vacuum pump on the basis of initial and operating costs. He went further to describe four-and five-stage jet ejectors, and showed unusual uses of this type of equipment.

Marketing

The marketing problems facing a company introducing a new plastic material were also aired for the **New Jersey Section** *(R. J. Boyle)* at its February meeting. From consideration of the marketing pattern evolved for a new plastic material, the factors involved in the development of the market possibilities were discussed by G. T. Borcherdt, Sales Mgr. of DuPont's Polychemicals Dept. From analysis of these market possibilities, the framework of marketing requirements keyed to the economic attractiveness, from the standpoint of producer, fabricators and ultimate

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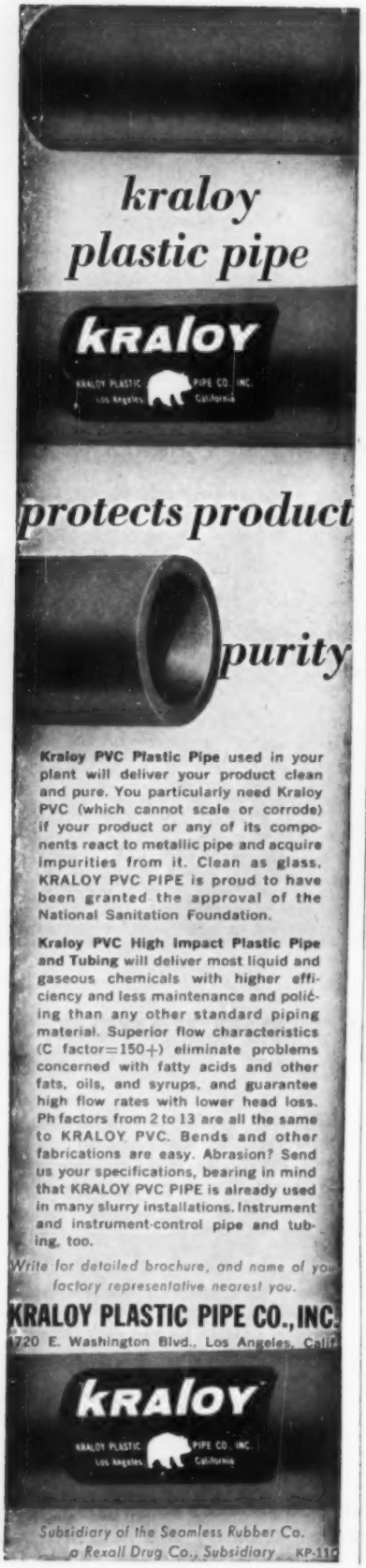
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consumers, was considered. On this framework, an approach to designing the marketing program based on relative profitability of alternative marketing programs was described. The presentation was wrapped up by a description of the requirements ultimately faced in ensuring the attractiveness of the venture, with particular emphasis on the continuing market research and analysis which must be built in as an integral part of the originally designed program.

Current investment trends and an explanation of the mechanics of the stock market were given to the **Oklahoma Section** *(R. C. Harrison)* in February by Thomas M. Bowlus of the Harris, Upham Brokerage Co.

An "authority on nothing" was the featured speaker at the **Memphis** *(Frank A. Anderson)* November local section meeting. The "authority" was George Jordan of Selas Corp., who spoke on the application of "holes" to the work of the chemical engineer. The holes, it seems, are porous membranes. He discussed the use of porous membranes in liquid-liquid, liquid-gas, and gas-gas separations. Several practical applications of these membranes were used to convey the message, such as; the conversion of plant steam to pure water, the separation of water from jet fuels, and the oxygenation of blood in an artificial lung.

Also meeting

Alton-Wood River *(J. G. Huddle)* learned of new uses for centrifugal extractors in the petroleum and petrochemical industry at its March meeting. N. R. Kaiser, of Podbielniak, discussed the advantages of centrifugal contractors over gravity and agitated contractors with respect to low holdup, reduced plant area, better yields due to higher efficiency, operability with low differential gravity systems, less cleaning, and in many cases, lower plant cost. . . . The ichthyolates of **Boston** *(R. L. Wentworth)* guested local high school science teachers in February to hear Paul E. Sandorff of MIT compare ballistic missile development in the U.S. and USSR (within limits of security, of course). The teachers agreed there could be much carry-over of this information to the classroom. Among the many difficulties mentioned besetting the launching of missiles, were the unanticipated "Kentucky potshots" taken at missiles in rail transit. . . . Backing the educational theme, the **Coastal Bend** section *(R. C. Brandquist)* held its second annual student counseling meeting in February. About 85 interested high school seniors from the surrounding area were shown a movie (courtesy of Universal Oil Products) delineating the responsibilities and duties of a chemical engineer in the oil industry. . . . A case history of test marketing as conducted by Dow before introduction of its Saran Wrap, was the subject of the **Detroit** *(Cliff. Armstrong, Jr.)* April meeting. An interesting point brought out, was that Dow had originally planned to make its sales pitch on the reusability of saran, but customers preferred to discard after one use. . .

Phil Olmstead, Chief Engr. of Gould Pump Co., Seneca Falls, N. Y. discussing the design and application of centrifugal pumps at December meeting of the Rochester section.

Atlanta Section's *(L. Hutzler)* Ladies Night meeting in January honored N. R. Maleady upon completion of his tenure as chairman of the section, and heard W. Paschall of Atlanta analyze America's Position in World Affairs . . . **Nashville Section** *(J. C. Murphy, Jr.)* in January heard W. P. Carlon of Du Pont discuss Man-Made Fibers and You. Carlon, a member of the Product Information Group in Du Pont's Textile Dept., gave a detailed account of the synthetic fiber picture today . . . **Northeastern New York Section** got the story of customer and motivation research at its Annual Ladies Night meeting in February. Mrs. J. Leary, of Woodward, Voss and Hevenor, was the speaker on the subject—What Makes It Sell? . . . **Oklahoma Section** *(R. C. Harrison)* investigated the situation of petrochemicals in the Panhandle region at its January meeting. Speaker H. L. Hays of Phillips Petroleum, analyzed the raw material reserves of the area, principal products, future potential.

Holbrook named Du Pont v-p and director

George E. Holbrook, general manager of Du Pont's Elastomer Chemicals Department, has been named vice-president, director, and a member of the Executive Committee of the company. Holbrook, currently president of the A.I.Ch.E., was a director of the Institute for two terms, 1950-1952 and 1954-1956, and in 1953 received its Professional Progress Award.

He joined Du Pont in a research position at Jackson Laboratory, Deepwater Point, N. J. Subsequent moves took him to the Chambers Works and then to Wilmington, where he became assistant director of the Development Department of the company. In 1952, Holbrook, on temporary leave from Du Pont, became deputy director, Chemical Division, Chemical, Rubber, and Forest Products Bureau of the National Production Authority; he subsequently advanced to director. He returned to Du Pont in late 1952, and by 1957 had advanced to general manager of the newly-created Elastomer Chemicals Department.

Paul J. Green has joined the development department of the Toilet Goods Division of Procter & Gamble.

R. B. Bird, professor of chemical engineering at the University of Wisconsin, is currently at the Laboratorium voor Physische Technologie of the Institute of Technology in Delft, Holland. Bird, who is a Fulbright exchange professor and Guggenheim fellow for 1958, is lecturing on Transport Processes in Flowing Media.

Blaw-Knox announces appointment of **Robert M. Sachere** as senior process engineer in its Chemical Plants Division. He will specialize in design and construction work for the chemical and petroleum industries.

Paul A. McKim has been named assistant general manager of the Research and Development Department at Ethyl Corp. McKim joined Ethyl in 1949, and has since been associated with its process development and chemical engineering activities.

In the course of a major reorganization of the Nitrogen Division, Allied Chemical and Dye, **E. W. Bowen** becomes an associate director, and **G. J. Coli** has been made director of operations engineering.

Esso Research and Engineering have named **Roger W. Richardson** to be manager of the office of refinery liaison. Richardson had formerly been associate manager of the unit.

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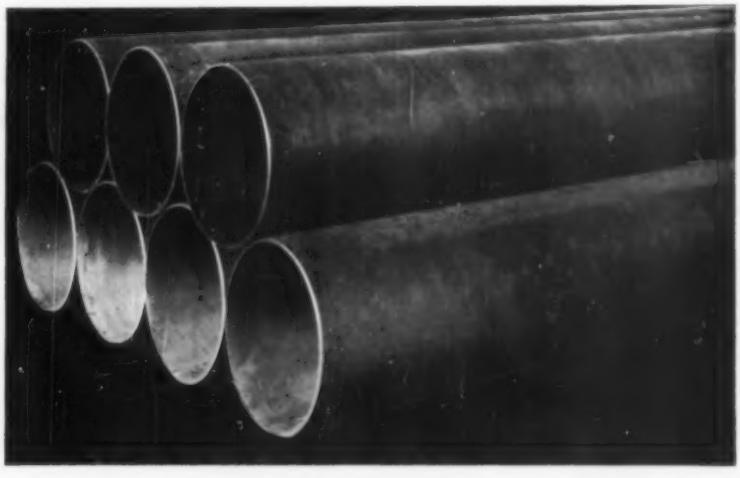

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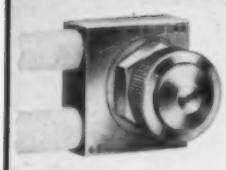

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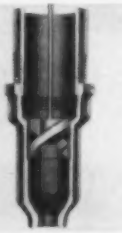

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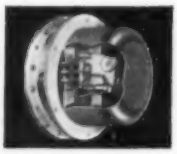

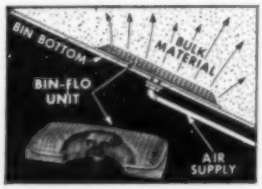

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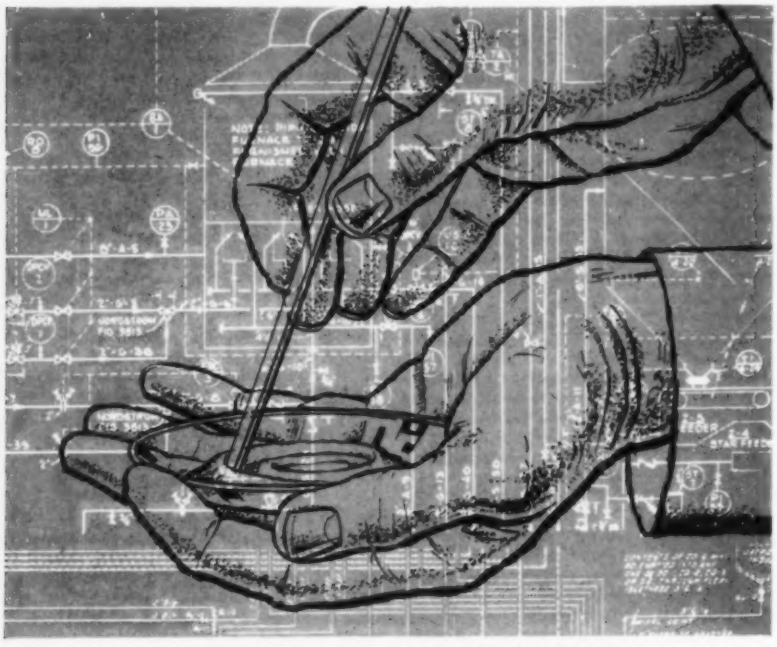

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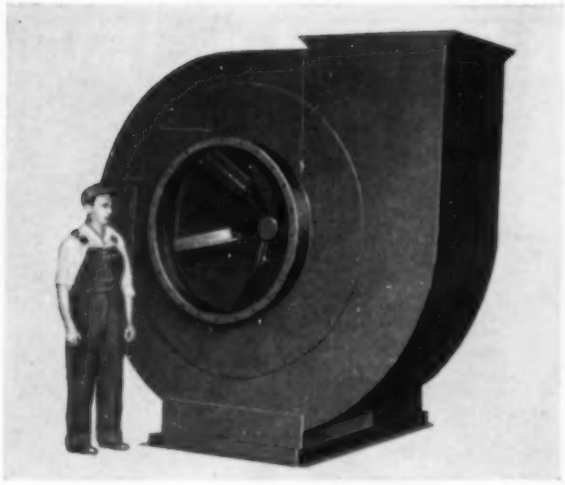

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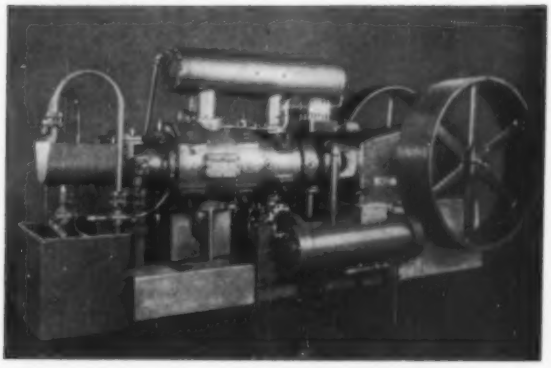

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from page 235

Coates honored

Jesse Coates (right), professor of chemical engineering at Louisiana State University, receives the first annual Charles E. Coates Memorial Award; the award honors Coates' father, who was head of the LSU chemistry department for more than 40 years. The award was made by Troy H. Middleton (left), president of LSU. Also shown are: C. F. Gray, chairman of the Coates Award Committee; Henry G. Allen, chairman of the Baton Rouge section of A.C.S.; and Thomas Landrum, chairman of the Baton Rouge section of A.I.Ch.E. Coates was selected to receive the award for his significant research contributions in the fields of liquid-state physical properties, simplified chemical engineering calculations, and the thermodynamics of solutions. Coates has been active in the development of engineering as a profession, and now serves as secretary of the Louisiana State Board of Registration for Professional Engineers. He has served also as chairman of the Baton Rouge section of A.I.Ch.E.

Among recent promotions in the Technical Service Division at Humble Oil & Refining's Baytown, Texas, refinery are: **William M. Harp** to technical associate; and **Irving Leibson** to technical specialist. Harp will adapt electronic computing equipment to solving engineering, scientific, and economic problems, while Leibson will be concerned with the development of new chemicals from petroleum. Also at Baytown, **C. H. Carney** becomes a senior design engineer in the Engineering Division.

Harp

Leibson

Raymond Wynkoop has joined Sun Oil Company's Research and Development Division as assistant director, petro-chemicals. Earlier positions held by Wynkoop include: assistant to the president of Houdry Process Corp.; and manager of sales for Catalytic Construction Co.

Newly-appointed assistant to the general manager in Monsanto Chemical's Overseas Division, St. Louis, will be **Salvadore P. Lio.** Lio served as manager of the Monsanto Mexicana S. A. plant at Mexico City for several years prior to rejoining the Plastics Division in 1956 as assitant manager of Lustrex sales. Also at Monsanto, St. Louis, **Fred J. Holzapfel** has been named director of engineering in the Organic Chemicals Division.

T. C. Dauphine, manager of products development department, Hooker Electro-chemical Co., has been elected a director of the Commercial Chemical Develpoment Association. He will serve from July, 1958, to July, 1959.

continued on page 244

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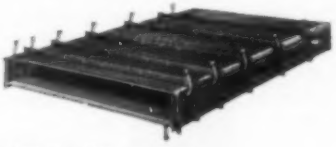

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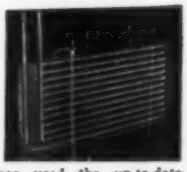

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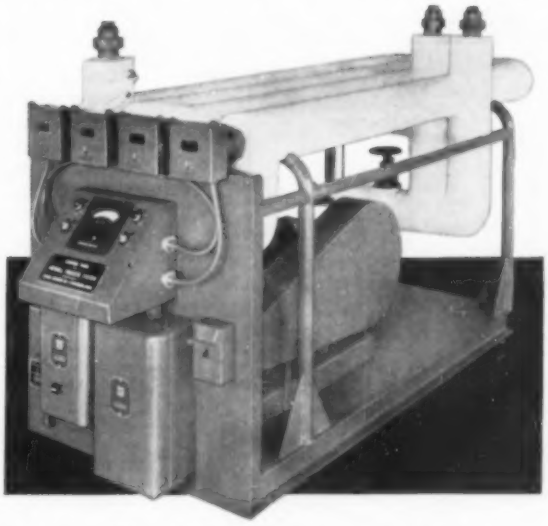

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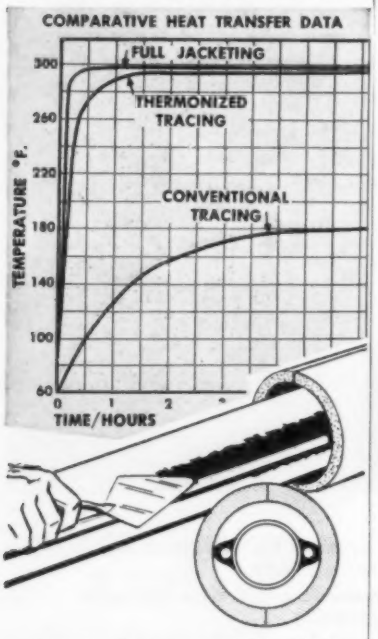

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from page 242

Albert J. Frey, vice-president in charge of the technical department of Hoffmann-La Roche, has retired after 42 years of service with the company. Frey joined Roche in 1915 in Basle, Switzerland, as a research chemist. Following his retirement, he will do consulting work in the chemical field.

Frey

After six years on the chemical engineering staff at Washington University, **R. Curtis Johnson** has joined the staff of Compumatix, Inc., St. Louis, Missouri. Curtis will direct the development of the computing program and the research department of the company.

Sinclair Research Laboratories announces the election of **Frank R. Fisher** as vice-president. Fisher was formerly secretary of Sinclair Research. He joined the Sinclair organization in 1940 in the research and development department, and was transferred to New York in 1951.

Fisher

Clarence R. Flynn has been named to head the technical department at B. F. Goodrich Chemical's new general chemical plant in Henry, Ill. At Goodrich's Development Center at Avon Lake, Ohio, **Arthur M. Pounds** has been appointed supervisor of new product development.

Eugene Krieger has transferred from the process engineering department of Wyandotte Chemicals Corp. to the chemical engineering research department of the company's Research and Engineering Division.

Joe T. Kelly has been promoted to section head in the petroleum section of the Research and Development Department of American Oil Co. Kelley joined the American Oil Co. as a chemist in March, 1948.

The annual award of the Philadelphia chapter of Alpha Chi Sigma, national professional chemical fraternity, has been presented to **William A. LaLande, Jr.,** vice-president of Pennsalt Chemicals Corp. The award was made for "outstanding services to the community, the chemical industry, and the profession."

Lecturing on chemical engineering at the Technion in Haifa, Israel, next year will be **Robert Lemlich,** assistant professor of chemical engineering at the Univerity of Cincinnati. Lemlich has been awarded a Fulbright lectureship for the academic year 1958-59.

Following the consolidation of Vulcan Engineering Division and Vulcan Construction Division into Vulcan - Cincinnati, Inc., **W. Douglas Beers** has been named general manager of the realigned engineering and construction activities at Vulcan.

Beers

Manager of a newly-formed Project Engineering Department at M. W. Kellogg is **H. P. Wickham,** formerly manager of the operating division, Process Department.

Chemstrand Corp. has promoted **Kenneth R. Lea** and **Terry W. Tarkington** to section heads in the pilot plant operations of their Research and Development Division. Lea will head a newly-created chemical section of the pilot plant, and Tarkington will manage the solution spinning section.

Thomas R. Kendrick III has been named technical manager of the Lawrence, Kansas, Division of Callery Chemical. Prior to joining Callery in 1953, Kendrick served on the research faculty of the University of Pittsburgh, and later with Mellon Institute of Industrial Research. Also at Callery, five chemical engineers have transferred to the new Lawrence Division. They are: **Richard A. Wright, Clair E. Hildebrand, Frank R. Wengrzyn, Charles J. Lanigan,** and **Jerardo Mongiello.**

Kendrick

Four promotions have been announced within the Tar Products Division of Koppers Co. **C. H. Teller,** formerly divisional production manager becomes assistant to the manager of operations; **W. B. Jackson,** formerly divisional assistant production manager will be manager of the Follansbee Group; **K. R. Caldwell,** previously assistant superintendent at the Follansbee plant, will be manager of the Chemical Group; and **H. R. Sulkowski** becomes assistant superintendent at the Follansbee plant.

continued on page 248

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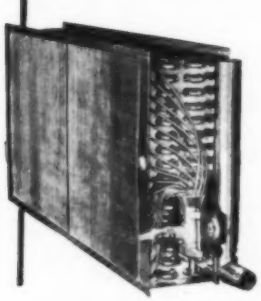

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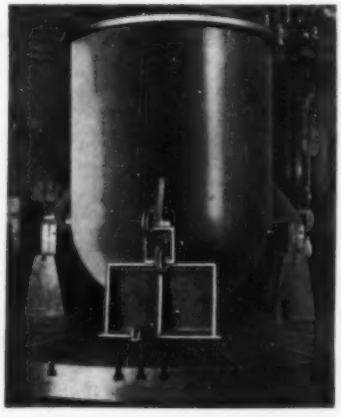

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PROJECT ENGINEER — B.Ch.E., M.S., P.E. Nine years' experience in process and project engineering of chemical and petro-chemical plants with major company. Supervising engineer and group leader in plant design and start-up operations. Desire position at managerial level. Minimum salary $12,000. Box 8-5.

CHEMICAL ENGINEER — Age 35. B.S.Ch.E., 1947. Honors. "Q" Cleared. Eleven years process development experience including silanes, plastics, and uranium. Present duties, administration and technical direction of corporate pilot plant activities. Present salary $10,000. Box 9-5.

PRODUCTION - MANAGEMENT ENGINEER—Fifteen years' experience as production supervisor, maintenance and plant engineer, quality control manager, and engineering department head in fine chemical, pharmaceutical and detergent plants. Proven administrative ability. Age 37, family. Box 10-5.

CHEMICAL ENGINEER—M.S., obtaining Ph.D. in Bus. Admin. Project leader with five years' diversified experience with major chemical company. Process development, reports, cost estimates—monomers, polymers, organics, latexes. Good organizer. Honor societies. Desire position with future within 50 miles of New York City; preferably in mkt. research, commercial aspects of chem. ind., economic evaluation. Box 11-5.

CHEMICAL ENGINEER—Ph.D. 1955, Business Administration minor. Age 28, married, family. Desire supervisory position with future. Three years experience in nuclear power plant development. Assignments covered technical problems, procurement, planning, budgets, and economic evaluations. Registered P.E. Minimum salary $11,500. Box 12-5.

CHEMICAL ENGINEER — B.S. 1948, age 32. Experience in structural materials testing, pilot plant operation, petroleum coke and active carbon. Desire position in San Francisco area. Box 14-5.

continued on page 248

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from page 244

Fox

At Dorr-Oliver, **William J. Fox** has been elected vice-president in charge of technological growth, and **Elliot J. Roberts** has been appointed company technical advisor. Fox came to Dorr-Oliver in 1949, after several years of teaching at Bridgeport Engineering Institute and Pratt Institute. Roberts joined the company in 1930 as a research chemist; in 1941 he was named director of research.

Roberts

The 1958 Jacob F. Schoellkopf Medal of the Western New York Section of the American Chemical Society goes this year to **Robert B. MacMullin,** senior partner of R. B. MacMullin Associates, Niagara Falls, N. Y. for "original contributions to the science of chemical engineering."

John B. O'Connor, president of Dresser Industries, has been awarded the honorary degree of Doctor of Commercial Science by St. Bonaventure University.

people in marketing

After 21 years as New Orleans sales branch manager for Solvay Process Division, Allied Chemical & Dye, **Carl O. Kingsbury** retired as of March of this year. Succeeding him is **Charles E. Varn,** who has been a salesman at Solvay's Charlotte, N. C., branch.

James D. Adams has been named western representative on the technical staff of Rowe Products, Inc., Niagara Falls, N. Y. Before joining Rowe, Adams supervised the testing of metals, protective coatings, and corrosion inhibitors for American Potash and Chemical Corp at Trona, Calif.

Adams

Carey

New directors at Badger Manufacturing Co., Cambridge, Mass., are **James S. Carey** and **Philip H. Seaver.** Carey has been manager of Badger's New York sales office since 1952, while Seaver has been a sales engineer with the company since 1951.

Seaver

O. R. Matzner has been made a sales engineer for Catalysts and Chemicals, Inc., Louisville, Ky. Matzner was formerly a catalyst sales engineer with the Girdler Co.

William E. McTurk has been named assistant director of the public relations division of Esso Research and Engineering. A chemical engineer, McTurk had five years with Esso.

Necrology

Stanley Fromholz, 58, since 1954 associated with the U. S. Government Ordnance Corps.

Edward Bartow, 88, professor emeritus of chemistry at the State University of Iowa. Bartow was head of the university's chemistry and chemical engineering departments from 1920 to 1940.

continued from page 247

CHEMICAL ENGINEER — M.S.Ch.E. Age 33, family. Eleven years' engineering experience including petrochemical process and equipment design, economic evaluation, plant technical service; also planning, supervision and evaluation of pilot plant process development. Prefer Gulf Coast or Southwest. Box 13-5.

PRODUCTION MANAGEMENT ENGINEERING —Age 40. M.Ch.E. Fifteen years' experience in chemical food processing and aerosol packaging plants. Plant manager, process engineer, process evaluation and development, production supervision, seeking responsible position in production management. Present salary $11,000. Box 15-5.

CHEMICAL ENGINEER—B.Ch.E. Has served as a technical advisor to an oil refinery since graduation, have also done instrumentation and automation studies. Desire position in process development or design. Age 22. Single and willing to travel. Box 16-5.

CHEMICAL ENGINEER—B.S., graduate courses past M.S. Taught Chemical Engineering six years. Petroleum refining economics and engineering experience last three years. Prefer process engineering or development. Age 32, family. Box 17-5.

CLASSIFIED SECTION RATES

Advertisements in the Classified Section are payable in advance at 24c a word, with a minimum of four lines accepted. Box number counts as two words. Advertisements average about six words a line. Members of the American Institute of Chemical Engineers in good standing are allowed one six-line Situation Wanted insertion (about 36 words) free of charge a year. Members may enter more than one insertion at half rates. Prospective employers and employees in using the Classified Section agree that all communications will be acknowledged; the service is made available on that condition. Answers to advertisements should be addressed to the box number, Classified Section, Chemical Engineering Progress, 25 West 45th Street, New York 36, N. Y. Telephone COlumbus 5-7330. Advertisements for this section should be in the editorial offices the 10th of the month preceding publication.

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news and notes of A.I.Ch.E.

Important Award will be announced at the Fiftieth Anniversary Meeting in Philadelphia, when five prominent chemical engineers will be the recipients of a new honor—of which more later. Be at Philadelphia to witness the event . . . the Local Arrangements Committee and the Program Committee are putting together a colorful and significant meeting that will be emblazoned on the annals of A.I.Ch.E.

United Engineering Center—President Holbrook recently signed the agreements for A.I.Ch.E. to become a member of the United Engineering Trustees and thus co-owners of the projected engineering center . . . Our formal acceptance as a member is now established, with the ratification of these contracts by the four other founder societies last month.

Meeting Change—Please note that the location of the Second National Heat Transfer Conference jointly sponsored by the A.I.Ch.E. and A.S.M.E. has been changed from Northwestern University to the Edgewater Beach Hotel in Chicago. . . . The dates remain the same, August 17-20 for the conference and August 18-20 for the exposition. More news of this conference has been sent to every member of A.I.Ch.E. and A.S.M.E. who is interested in heat transfer. If you don't get a notice it merely means that you are not on record as being interested in the subject. How about rectifying that by writing to the national office that your specialty is heat transfer?

Note, A.A.A.S. Members—All Members of A.I.Ch.E. who are also members of the American Association for the Advancement of Science are qualified for automatic fellowship in the A.A.A.S. . . . The Institute has been notified that any A.I.Ch.E. member currently a member of the A.A.A.S. who does not have an A.A.A.S. fellowship certificate need only inform the Association in Washington.

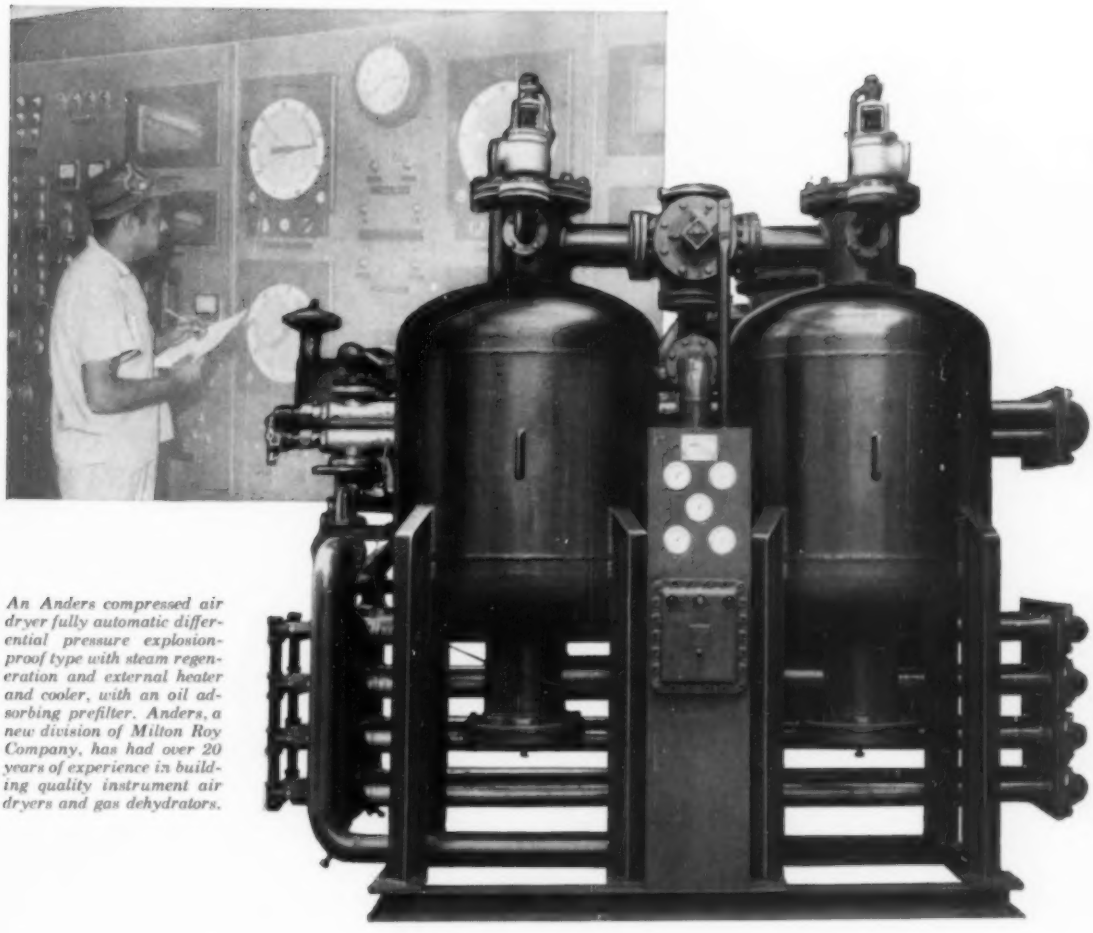
Nominating Committee has been formed as noted in the March issue of this column. . . . R. P. Dinsmore, a former Director of A.I.Ch.E. and a vice-president of Goodyear Tire and Rubber Company, is chairman, & serving with him this year will be R. H. Wilhelm, Princeton; E. B. Chiswell, California Research; J. J. Healy, Monsanto; J. J. McKetta, Texas U.; W. T. Dixon, Atlantic Refining. For Local Sections considering sending suggestions to the Nominating Committee or sending in a petition, here is the important schedule that must be met if their candidates are to get maximum publicity. The By-laws require the Nominating Committee to bring in its slate of officers & directors at least twenty weeks before the Annual Meeting, so that the candidates may be publicized in *Chemical Engineering Progress*. The Nominating Committee's suggestions will be in therefore by July eighteenth & will appear in the August issue of *Chemical Engineering Progress*.

Although the Constitution requires that nominating ballots be received no later then nine weeks prior to the Annual Meeting, or by October third, my advice to sections considering a petition is: if you wish to be fair to the candidate please try to get the biographical data, pictures, etc., etc., into A.I.Ch.E. headquarters, along with the petition signed by the required number of members, absolutely no later than July fifteenth . . . otherwise there can be no guarantee that it will appear in the August issue with those of the other candidates.

Sabine Area Activities—Sabine Area Local Section of A.I.Ch.E. has turned in a terrific report of activities to Jerry McAfee, its Council liaison member. (If you do not know about Council liaison members for Local Sections write and we will tell you about them.) The Sabine Area designated last November as Prospective-member Night & personal invitations were extended by members to engineers who were considered prospects for National membership, with the inducement that prospective members might attend the cocktail hour & dinner for the price of the dinner alone. Also, in addition to a complete technical program of its own, the section had a joint meeting with the local A.C.S. section, participated with the Texas Society for Professional Engineers in National Engineers' Week, & gave a $250 scholarship to a student at Warren College—all this activity by 138 members.

North vs. South—The March results of the membership contest between the North & South show that the Northern forces under General Sam West of Rohm & Haas are ahead some 130 to 99. He issued a communique to A.I.Ch.E. Northern divisions & unlike any general in history forwarded a copy to his rival, General Irv Leibson, of the Southern forces, who is with Humble Oil & Refining. Sam said that his troops in Philadelphia-Wilmington are the snappiest & are naturally in first place. He wants some competition for them. "Irv retaliated by calling upon the colonels of the Southern Division to regroup, organize, & attack & he hopes to bring in enough to make Philadelphia-Wilmington & the North scramble for their honor. Actually, the letter that Leibson, West, & Matt Jones sent out on membership contained some of the most potent arguments that have yet been drafted & any Local Section chairman, officer, etc., who wishes copies of these need only write us to be put on the mailing list. The activity & intensity that all A.I.Ch.E. committee men bring to committee work never ceases to amaze & gratify, for if there is any hallmark of professional stature & growth this is certainly it. All chemical engineers, the nation & science & engineering in general are immeasurably benefited by the unselfish devotion of such people.

F.J.V.A.



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Now there's no maintenance headache, because no steady bearing is needed; so production keeps moving without costly stoppages.

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What this man can do for you

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